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April 1990

Smithsonian

Volume 21, Number 1

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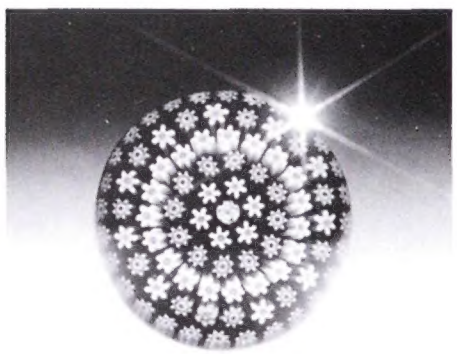

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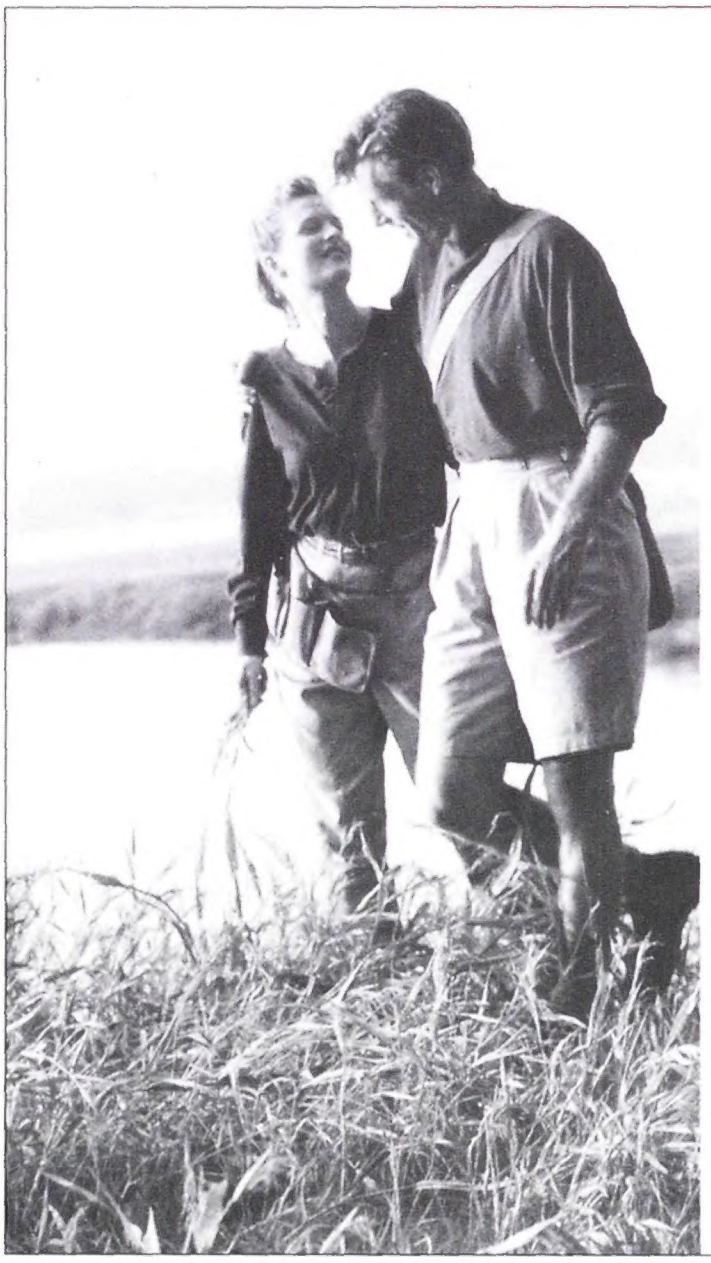

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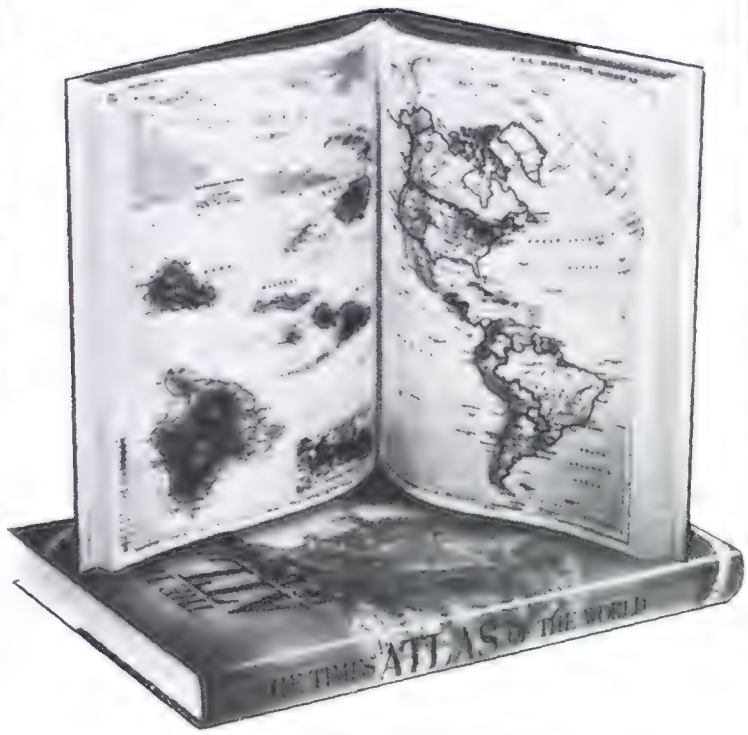

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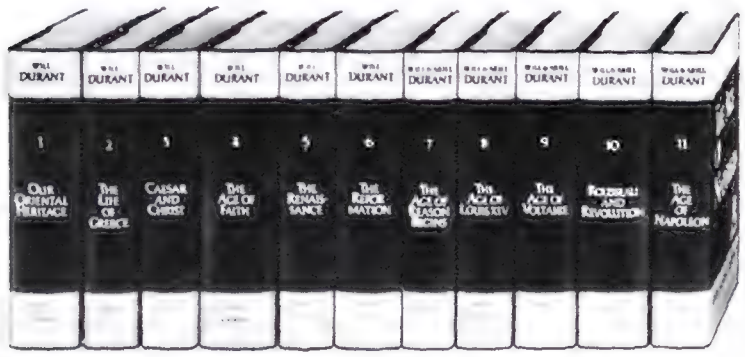

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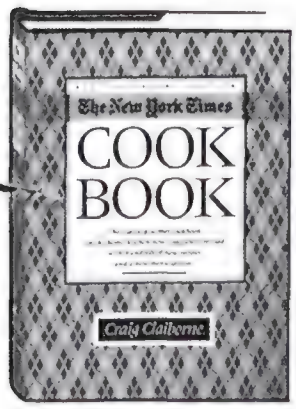

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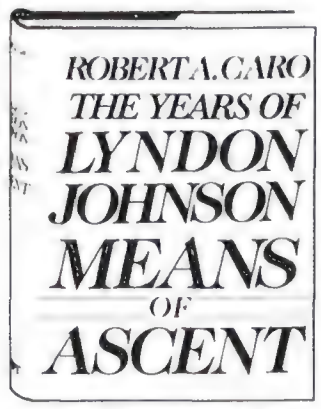

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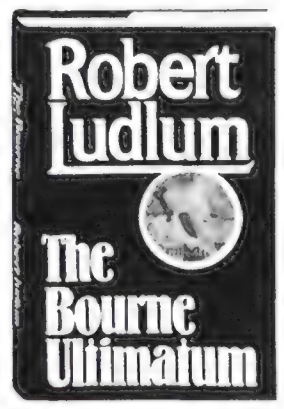

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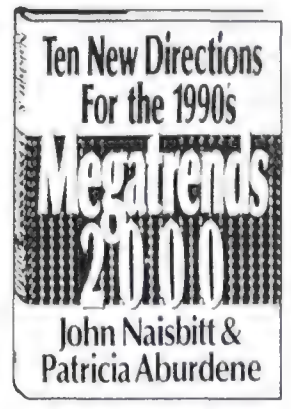

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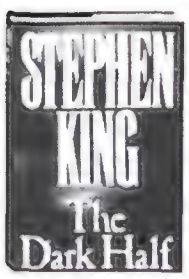

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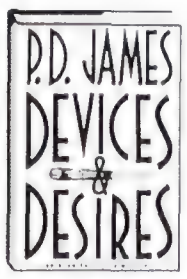

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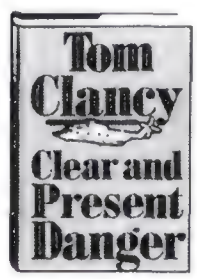

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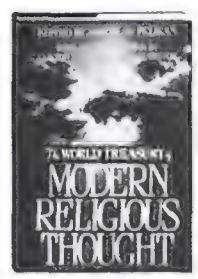

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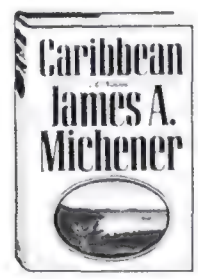

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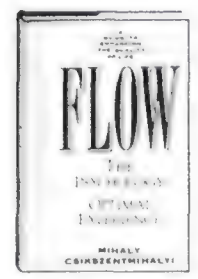

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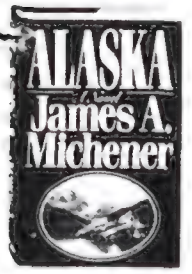

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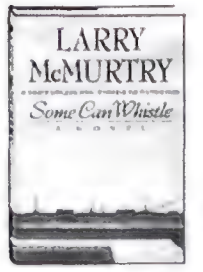

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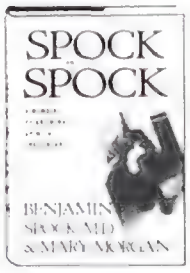

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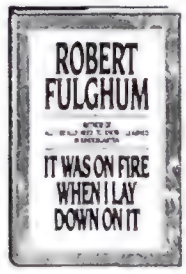

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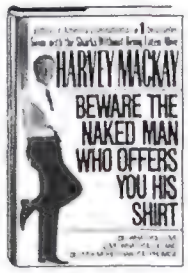

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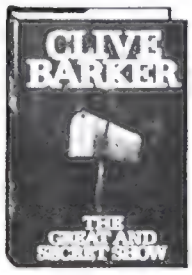

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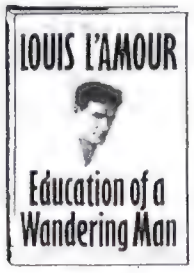

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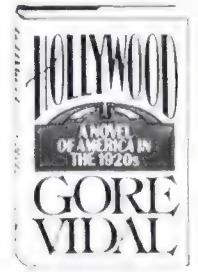

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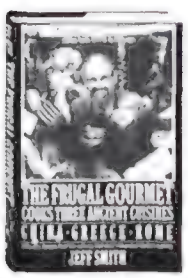

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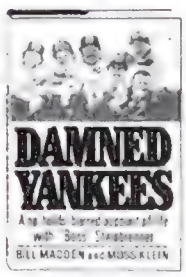

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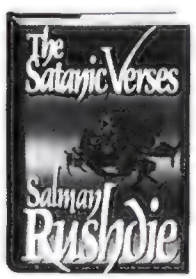

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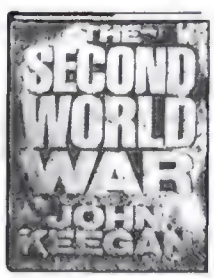

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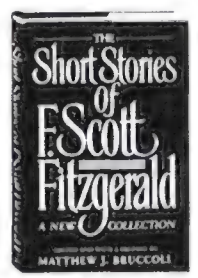

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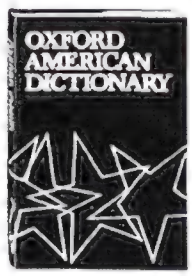

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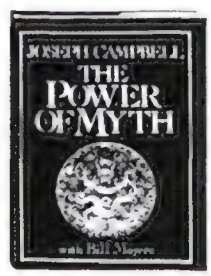

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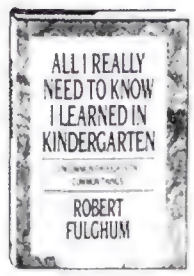

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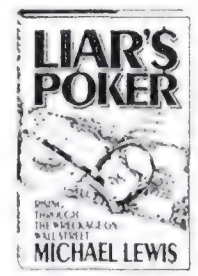

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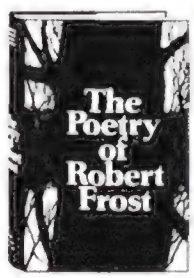

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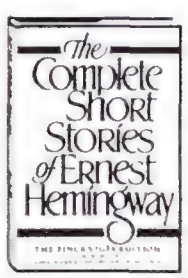

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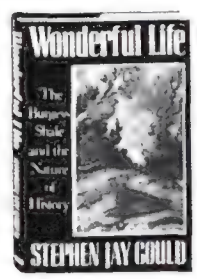

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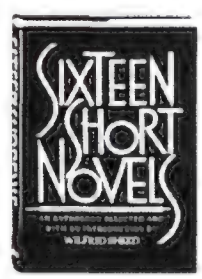

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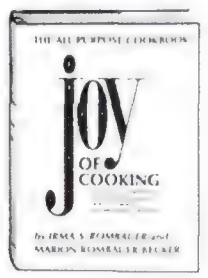

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Secretary Adams' comments

Smithsonian horizons

The challenge for us is to identify the most crucial issues of biotic extinction and go to work on them

Humankind has been uniquely effective as a disturber of ecosystems and an agent of species dispersal. Imagine only the probable consequences of a few well-established, long-distance movements. Seafaring merchants from Ur in the late third millennium B.C. rode the rhythm of the monsoons to India. Phoenician sailors mastered the Mediterranean a thousand or so years later, linking the Levant to mines and colonies in Spain. By some reports they had even circumnavigated Africa, and in any case Arab sailing records confirm knowledge of an east-to-west route well before Vasco da Gama rounded the Cape of Good Hope in the opposite direction.

And this says nothing of scores (or thousands?) of less well attested or more mundane Old World journeys before the great voyages of European discovery: the Indo-European diaspora; Roman coins in Southeast Asia; waves of Crusaders reversing the route of the Phoenicians; Chinese naval expeditions bringing back African animals for the emperor's zoo; a massive, seaborne migration from the East Indies to Madagascar; Marco Polo . . .

Carried along by travel and turmoil on this scale, whether by land or sea, were all kinds of more or less involuntary baggage—weeds, pests, diseases (and hence resistance to them), domesticated plants and animals, basic technologies. But the vast reaches of the Atlantic and Pacific oceans were still a barrier. Given this isolation, the arrival of Europeans in the New World led to biological transformations and cataclysms no less profound and lasting than the conquests themselves.

Far deadlier than muskets in their impact on Indians were smallpox and measles, while syphilis is thought to have moved in the opposite direction. Maize and tobacco raced around the world almost as quickly as the first circumnavigating galleons. The horse, long extinct in the Americas, was readily "borrowed" and permanently embedded in native cultures.

Wholesale shifts and replacements of natural biota, although largely unnoticed by contemporaries, were often even more sweeping than these examples. It is worth remembering that since 1800 the number of introduced insect species in the United States has grown from about 36 to more than 1,200, and that none of the world's 20 most important food crops was native to North America north of Mexico. All this is the stuff of a major exhibition at our National Museum of Natural History, "Seeds of Change," planned for the Quincentenary of Columbus' voyage.

Alfred Crosby, who has written brilliantly of these matters, recently noted that the significance of the 1492 encounter "marks one of the major discontinuities in the course of life on this planet." He likens it to the great divisions of geological history, also sometimes characterized by "large numbers of extinctions and the proliferation of new species." But we must think of the extinctions immediately following 1492 less as events than as the onset of a process that has now begun to accelerate disastrously.

The greatest threat is to tropical rain forests, ecologically most fragile and attractive to desperately needy (and rapidly growing) populations of subsistence farmers, as well as to ranching and lumbering interests. These forests are also richest by far in the proliferation of unknown species. Insects and other invertebrates are by all odds the most numerous, but it is illustrative that a recent Smithsonian-Princeton University study in the lowlands of Malaysia found 835 tree species within a plot of about two-tenths of a square mile—more than occur in all of the United States and Canada. It is in areas like this that the world has most to lose of the biogenetic diversity that is the heritage of a billion years of evolution. As a report to the National Science Board indicates, "the rate of extinction over the next few decades is likely to rise to at least 1,000 times the normal background . . . and will ultimately result in the loss of a quarter or more of the species on earth."

The Smithsonian, I am happy to report, is in the thick of these studies. Major efforts are under way in the greater Amazon basin, the largest of them aptly named Biological Dynamics of Forest Fragments. Other Smithsonian scientists have concentrated on island ecosystems, where Man's negative impact on biodiversity probably has been most catastrophic and in any case can be most accurately plotted. More than two-thirds of the native land birds of the Hawaiian archipelago are now extinct, for example, with more than half apparently having disappeared as a result of prehistoric human pressure, long before the arrival of Captain Cook.

These many facets add up to a grim picture that allows no real grounds for optimism. Most of the ongoing loss seems very likely to occur before any record can be made of it. But the challenge is to identify the issues of most crucial concern and then, by setting to work on them, to both know and extend this geological era as well and as much as we can.

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SELDANE® (terfenadine) Rx prescription only	sneezing runny nose itchy eyes watery eyes	**YES**†
OTC ANTIHISTAMINES†† Benadryl® Chlor-Trimeton®	sneezing runny nose itchy eyes watery eyes	**NO**
OTC DECONGESTANTS†† Sudafed®	nasal congestion	**YES**
OTC COMBINATIONS†† Allerest® Dimetapp® Actifed® Drixoral® Contac® Dristan®	sneezing runny nose itchy eyes watery eyes nasal congestion	**NO**

*Definition of "risk of drowsiness" is incidence greater than placebo (a sugar pill)
†The reported incidence of drowsiness with Seldane (5.8%) in clinical studies involving more than 11,000 patients did not differ significantly from that reported in patients receiving placebo (6.9%)
**Based on worldwide prescription and distribution information (1986-1989)—data on file
††Source: *Physicians' Desk Reference for Nonprescription Drugs*®. Oradell, NJ: Medical Economics Company, Inc., 1989
SEE BRIEF SUMMARY OF PRESCRIBING INFORMATION ON NEXT PAGE

To get the booklet, "The facts about what allergy medicines do...and don't do," call:

1-800-4-HAY FEVER

SELDANE®

(terfenadine) 60 mg tablets

Ask your doctor if it's right for you.

MDS-595 January, 1990

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Seldane®

(terfenadine) 60 mg Tablets

BRIEF SUMMARY: CAUTION Federal law prohibits dispensing without prescription

DESCRIPTION: Seldane (terfenadine) is available as tablets for oral administration. Each tablet contains 60 mg terfenadine. Tablets also contain, as inactive ingredients, corn starch, gelatin, lactose, magnesium stearate, and sodium bicarbonate.

INDICATIONS AND USAGE: Seldane is indicated for the relief of symptoms associated with seasonal allergic rhinitis such as sneezing, rhinorrhea, pruritus, and lacrimation.

CONTRAINDICATIONS: Seldane is contraindicated in patients with a known hypersensitivity to terfenadine or any of its ingredients.

PRECAUTIONS

Information for patients Patients taking Seldane should receive the following information and instructions. Antihistamines are prescribed to reduce allergic symptoms. Patients should be questioned about pregnancy or lactation before starting Seldane therapy, since the drug should be used in pregnancy or lactation only if the potential benefit justifies the potential risk to fetus or baby. Patients should be instructed to take Seldane only as needed and not to exceed the prescribed dose. Patients should also be instructed to store this medication in a tightly closed container in a cool, dry place, away from heat or direct sunlight, and away from children.

Carcinogenesis, mutagenesis, impairment of fertility

Oral doses of terfenadine, corresponding to 63 times the recommended human daily dose, in mice for 18 months or in rats for 24 months, revealed no evidence of tumorigenicity. Microbial and micronucleus test assays with terfenadine have revealed no evidence of mutagenesis.

Reproduction and fertility studies in rats showed no effects on male or female fertility at oral doses of up to 21 times the human daily dose. At 63 times the human daily dose there was a small but significant reduction in implants and at 125 times the human daily dose reduced implants and increased post-implantation losses were observed, which were judged to be secondary to maternal toxicity.

Pregnancy Category C: There was no evidence of animal teratogenicity. Reproduction studies have been performed in rats at doses 63 times and 125 times the human daily dose and have revealed decreased pup weight gain and survival when terfenadine was administered throughout pregnancy and lactation. There are no adequate and well-controlled studies in pregnant women. Seldane should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nonteratogenic effects: Seldane is not recommended for nursing women. The drug has caused decreased pup weight gain and survival in rats given doses 63 times and 125 times the human daily dose throughout pregnancy and lactation. Effects on pups exposed to Seldane only during lactation are not known, and there are no adequate and well-controlled studies in women during lactation.

Pediatric use: Safety and effectiveness of Seldane in children below the age of 12 years have not been established.

General: Consideration should be given to potential anticholinergic (drying) effects in patients with lower airway disease, including asthma.

ADVERSE REACTIONS: Experience from clinical studies, including both controlled and uncontrolled studies involving more than 2,400 patients who received Seldane, provides information on adverse experience incidence for periods of a few days up to six months. The usual dose in these studies was 60 mg twice daily, but in a small number of patients, the dose was as low as 20 mg twice a day, or as high as 600 mg daily.

In controlled clinical studies using the recommended dose of 60 mg b.i.d., the incidence of reported adverse effects in patients receiving Seldane was similar to that reported in patients receiving placebo. (See Table below.)

ADVERSE EVENTS REPORTED IN CLINICAL TRIALS

Adverse Event	Percent of Patients Reporting				
	Controlled Studies*			All Clinical Studies**	
	Seldane N=781	Placebo N=665	Control N=626***	Seldane N=2462	Placebo N=1478
Central Nervous System					
Drowsiness	3.0	3.1	18.1	8.5	8.2
Headache	6.3	7.4	3.8	15.8	11.2
Fatigue	2.9	0.9	5.8	4.5	3.0
Dizziness	1.4	1.1	1.0	1.5	1.2
Nervousness	0.9	0.2	0.6	1.1	1.0
Weakness	0.9	0.6	0.2	0.6	0.5
Appetite Increase	0.6	0.0	0.3	0.5	0.0
Gastrointestinal System					
Gastrointestinal Distress (Abdominal distress, Nausea, Vomiting, Change in Bowel habits)	4.6	3.0	2.7	7.6	5.4
Eye, Ear, Nose, and Throat					
Dry Mouth, Nose, Throat	2.3	1.5	3.5	4.6	3.1
Cough	0.9	0.2	0.5	2.5	1.7
Sore Throat	0.5	0.3	0.5	3.2	1.6
Epistaxis	0.0	0.8	0.2	0.7	0.4
Skin					
Eruption (including rash and urticaria) or itching	1.0	1.7	1.4	1.6	2.0

*Duration of treatment in "CONTROLLED STUDIES" was usually 7-14 DAYS

**Duration of treatment in "ALL CLINICAL STUDIES" was up to 6 months

***CONTROL DRUGS: Chlorpheniramine (291 patients), d-Chlorpheniramine (189 patients), Clemastine (146 patients)

In addition to the more frequent side effects reported in clinical trials (See Table), adverse effects have been reported at a lower incidence in clinical trials and or spontaneously during marketing of Seldane that warrant listing as possibly associated with drug administration. These include: alopecia, (hair loss or thinning), anaphylaxis, angioedema, arrhythmia (including ventricular tachyarrhythmia, torsade de pointes and ventricular fibrillation), bronchospasm, confusion, depression, galactorrhea, hypotension, insomnia, menstrual disorders (including dysmenorrhea), musculoskeletal symptoms, nightmares, palpitation, paresthesia, photosensitivity, prolonged QT interval, seizures, sweating, syncope, tachycardia, tremor, urinary frequency, and visual disturbances. In clinical trials, several instances of mild, or in one case, moderate transaminase elevations were seen in patients receiving Seldane. Mild elevations were also seen in placebo treated patients. Marketing experiences include isolated reports of jaundice, cholestatic hepatitis, and hepatitis, in most cases available information is incomplete. In neither the clinical trials nor marketing experience is a causal relationship of liver abnormalities to Seldane use clear.

OVERDOSAGE: Information concerning possible overdosage and its treatment appears in Full Prescribing Information.

DOSAGE AND ADMINISTRATION: The usual dosage for adults and children 12 years and older is 60 mg (1 tablet) twice daily.

Product Information as of January, 1990 Y460D

MERRELL DOW PHARMACEUTICALS INC.
Cincinnati, Ohio 45215, U.S.A.

Merrell Dow

U.S. Patent 3,878,217
Other patent applications pending

Letters to the Editor

The genome

Dear Sir: Your February article struck a long-forgotten chord. My wonderful high school biology teacher, instructing us on DNA, injected her own historical footnote.

As Miss Janine Torbe pointed out to her tenth-graders, with righteous indignation, Rosalind Franklin never got a share of the 1962 Nobel Prize. It went to Watson, Crick and Wilkins.

In this age of changing sex roles, science continues to be the great windowless fortress of male chauvinism. I thank you for keeping Rosalind Franklin from being forgotten as a significant contributor to genetics.

Regarding the photo of Jonathan Beckwith (page 45), how appropriate that a member of the ethics panel be pictured with a halo.

KJ Sciandra
Minneapolis

John Marin

Dear Sir: As a boy in the 1960s, I often admired a brilliantly colored and energetic seascape hanging on the wall of my great aunt Kathryn Greywacz's home in Trenton, New Jersey. Then curator of the New Jersey State Museum, as well as a collector, she always seemed 25 years ahead of her time, one reason she was our proverbial "favorite aunt."

A stroke and her confinement to a nursing home necessitated her estate's being sold at auction in 1973. Only when I received a detailed auction list did I discover the name of the artist of the watercolor I had so admired. Alas, I was one day too late to have that John Marin withdrawn from auction. It would have been a valued possession, and a cherished memory of a great and wonderful lady, who was so aware of Marin's artistic talents.

Thom Miller
Mission Viejo, California

Dear Sir: The watercolor on the bottom of page 55 reminds me of an old *Li'l Abner* comic strip, when Pappy Yokum went to Paris, tipped over some paint, slid in his bare feet across a canvas and won a first prize.

Helen L. Belz
Andover, Ohio

P.D.Q. Bach

Dear Sir: At last! Someone finally recognizes the musical genius of Peter Schickele. In the 1970s I belonged to a small choral group. Our spring concerts followed the format of classical for the first half of the program and, after intermission, blues, jazz and medleys from Broadway musicals. In 1979 we had an innovative director who decided we should do something different. P.D.Q. Bach's "The Queen to Me a Royal Pain Doth Give," sung as a madrigal, was greeted, at first, in stunned silence. In midsong there were heard titters and giggles, and at the last note, a round of hearty applause and laughter.

Anne Mazanek
Queensbury, New York

Dear Sir: In the late 1960s Mr. Schickele and his troupe of musicians visited the Mosque Theater in Newark, New Jersey. He startled all of us by sliding down a rope from the front of the balcony to stage center. What a relief when he arrived safely! The program was full of his usual jokes, including an aria for bargain counter tenor.

I witnessed another side of Schickele's professional life. He was pumping out soft-rock organ music as an accompaniment to the first *Oh, Calcutta!*, at the rickety old Eden Theatre deep in New York City's East Village.

Alan G. Branigan
Nutley, New Jersey

Dear Sir: A few years ago the Cincinnati Pops Orchestra had Schickele on a pre-subscribed series. People began to exit after 30 to 40 minutes, and by intermission the Music Hall was half empty. It was almost completely empty when we, trapped by having driven with friends of the company's manager, left.

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Schickele's airheaded approach, lack of any real humor and taste, unlimited gall and generally impossible demeanor were appalling. He was an insult to the intelligence of an audience that wholeheartedly supports a symphony, ballet, live theater and many other facets of the arts of Cincinnati.
Ms. H. M. Churchill
Fairfield, Ohio

Dear Sir: I was introduced to P.D.Q. in high school, where my choir director had us perform the not-so-sacred oratorio *The Seasonings*, in addition to several of P.D.Q.'s madrigals and Christmas carols. Your article has prompted me to search out my long-lost copy of Schickele's *The Definitive Biography of P.D.Q. Bach*. With a decade of musical training and performance now behind me, I found everything from his musical notation to his detailed account of P.D.Q.'s life more entertaining than ever. Any musician who can't laugh at P.D.Q. is taking his art, or himself, much too seriously!
Yvonne Grover
South Hero, Vermont

The plague

Dear Sir: The "ten-year-old treacle mixed with several dozen items, including chopped-up snake" in Charles Mee's article was an ancient and venerated medicine. The word "treacle" is from the Greek *theriac*, a multi-ingredient medicine that always included, if a genuine theriac, chopped, powdered or distilled vipers, as well as opium, honey and a slew of other ingredients, many very rare and difficult to obtain. "Treacle" in English came to mean "molasses" only in the 17th century.

The best-known theriac was named in the second century by Galen for its supposed inventor, Andromachus, who first added viper. It was used for snake bites, and as a prophylactic against poisons and diseases of all sorts. The original recipes called for periods of storage of up to ten years to allow all 50 or so ingredients to ferment and blend, thereby supposedly increasing its power.

Its use as a medicine was still widespread in England as late as the 18th century, when it was finally expelled from the British pharmacopoeia.

The beak of the mask worn by plague doctors was a receptacle in which were placed sweet-smelling oils, herbs, and perhaps even a theriac as hopeful protection for the physician.
Bernadine Z. Paulshock, M.D.
Wilmington, Delaware

Brancacci Chapel

Dear Sir: You stated that Masaccio's name means "scatterbrain." In Italian, nicknames are formed from the last part of the first name, i.e., Vincenzo—Enzo; Tommaso—Maso. The ending *-accio* translates as "naughty" or "careless." Tommaso di Ser Giovanni di Mone, born in 1401, has come down in art history as Masaccio, loosely translated as "Careless Tom." Vasari states the name was changed "not indeed because he was bad, for he was goodness itself, but by reason of his great carelessness." "Scatterbrain" is rendered as *scervellato*; literally, "dis-brained," the initial "s" denoting a negative.

As many Italian artists are known by their nicknames or their "place names" (Cimabue, Sodoma, Veronese, Tinto-

retto), Masaccio, despite the seeming pejorative cast of his nickname, stands in superlative company, within a long and glorious Italian tradition.
Donald Fricelli
Fordham University
New York City

Biblical zoo

Dear Sir: In 1981-82 I was in the Negev as a civilian employee of the U.S. Army Corps of Engineers, working on the Israeli Airbase program. On my day off I would journey to a nearby canyon to watch the ibex. During the day they grazed on the sparse desert foliage, returning at dusk to the canyon for protection from predators.

This herd of about 50 individuals and their offspring would clatter noisily but effortlessly down the steep, sometimes almost sheer, canyon sides. One evening there was a tremendous racket from the tree behind me. I turned to find that an ibex had climbed the tree and was gazing down at me.
Michele Farritor McMurray
Colorado Springs

Brighton Run

Dear Sir: My wife and I are the owners who, during the 1988 Run, nursed our chain-driven Oldsmobile to Brighton, as mentioned in your article.

It is worth noting that the United States has a similar event, younger and, so far, smaller than its English counterpart. Minnesota's New London to New Brighton Run is held two Saturdays before Labor Day. This year's will be the fourth annual, and we expect more than 100 cars. It is limited to 1908 vintage or earlier, as well as any models with one- or two-cylinder engines. Not to be outdone by the British, our Run is 126 miles, twice the distance and ten times the fun! Last year we had four cars from the U.K.
Gary Hoonsbeen
Minneapolis

Phenomena

Dear Sir: Luis Naranjo's plea for help for South American ornithologists, especially for equipment, leads me to wonder whether one source of help might not be schoolchildren. School classes could "adopt" a bird or a group that studies birds. Even if such a project produced only a handful of binoculars, nets, scales and calipers for bird study, it would spark the interest of children in birds. Moreover, they would become more attuned, in a personal way, to the problems of South and Central America and the critical environmental links between "them" and "us."
Elizabeth M. Weber
Schenectady, New York

Book reviews

Dear Sir: William Dieter's review of *Continental Dash: The Russian-American Telegraph* makes no mention of a true classic covering the Siberian portion of that epic of man against wilderness. First published in 1871, it was *Tent Life in Siberia*, by George Kennan, a young American explorer and telegrapher who survived that awesome ordeal and went on to become a well-traveled journalist and author.
William C. Chapman
Arlington, Virginia

Joe Norris/Folk Artist

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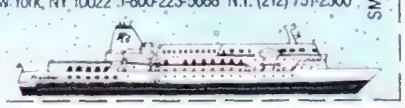

SMF4

Around the Mall and beyond

Like New Yorkers who never visit the Empire State Building, we who live in Annapolis, Maryland, tend to overlook a neighboring wonder, a prized Smithsonian establishment only a few miles south of us, along the Rhode River, which is really just an arm of the Chesapeake Bay. In fact, we used to call it the Chesapeake Bay Center, though its real title included "for Environmental Studies." Now, when you enter its offices, you see a display of T-shirts and caps emblazoned with the words "Smithsonian Environmental Research Center." That small change brought home to me my shocking failure to keep tabs on this beautiful bayside facility, so close at hand, so taken for granted.

You'll note a few other changes if, like me, you haven't visited SERC for a decade: there are new buildings and more staff. But you still find it by following a series of roads that gradually diminish in grandeur as they grow in scenic delight. By the time you reach its Visitors Center, you are almost a country driver, your eyes attuned to field and forest instead of white line and taillight.

Forest envelops most of the 2,600-acre Center. Tall trees stride down to the shoreline and shelter the Smithsonian's main building, their lofty canopy shading the swales and gullies that carry trickles of runoff into the Rhode River and the Chesapeake. Those streamlets are grist for the Center's laboratories. What they carry is what forms this great estuarine system and helps to determine its future.

The main building, a white U-shaped office-laboratory complex, sits between two old silos, relics of the dairy farm that used to operate here. I arrived on a bitter and blustery winter day when the

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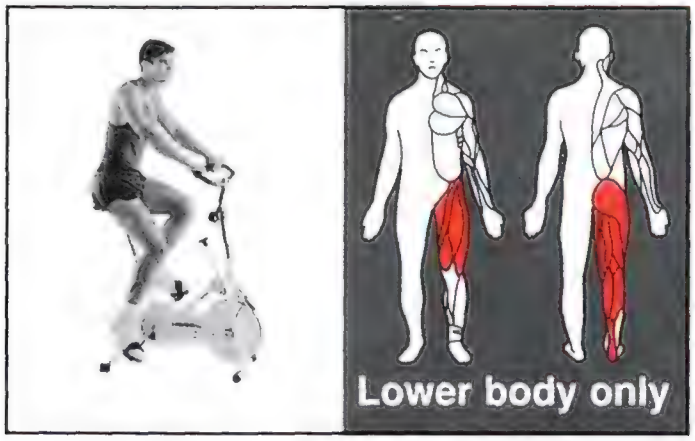

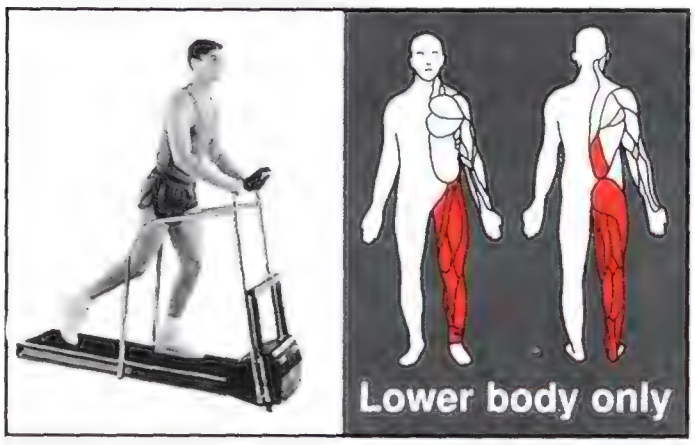

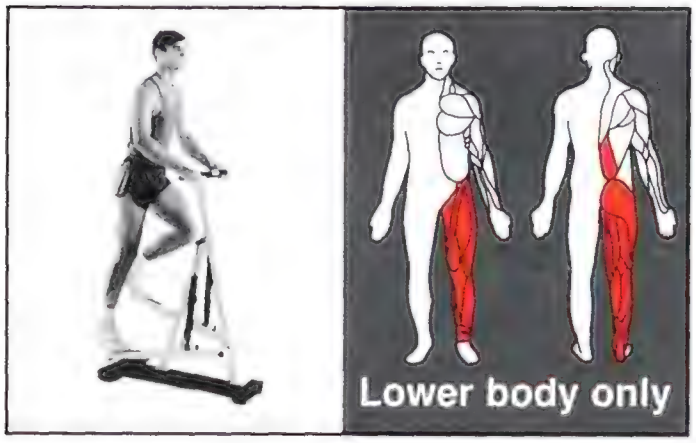

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Sampling station at the Smithsonian Environmental Research Center monitors water and aquatic life in marsh fringing the Chesapeake Bay.

simple structure seemed pitifully fragile, the trees surrounding it too bare and bony to offer protection from the chill, relentless wind.

But inside, the place was warm, cheerful and active. "Our winter staff comes to about 65 people," said Acting Assistant Director Anson (Tuck) Hines. "Other bigger and richer scientific establishments keep tabs on the Chesapeake. But their research projects tend to be short-term. Ours are long-term, focused primarily on this site."

He gave me a quick tour of the laboratories, thrusting me into one after another with a brief outline of the work done in each. First: Director David Correll's lab. "He's been here since the early '70s. He set up our system of little weirs on runoff streams. They allow him to take samples and check them for things like acid rain and nutrient concentrations."

Other labs revealed a spectrum of specialties. Bert Drake, for example, came here from the Smithsonian's old Radiation Biology Laboratory after it was closed down. Now he heads a group that monitors the impact on a salt marsh of another of our problems, increasing atmospheric carbon dioxide—the greenhouse effect.

Center scientists also study how light affects microscopic life underwater, and what air pollution does to the forest canopy. They probe the private lives of migratory birds, mud-dwelling invertebrates and forest plants, and track the fluctuations in their populations.

I noticed that each lab had its own smell: marsh gas, chemicals, damp clothing, just plain mud. A computer room clicked and beeped as data from outlying labs and instruments were fed into its terminals. An outside building—the erstwhile calf barn—had been recently transformed into a new library.

Bundling into warm jackets, Hines and I set out to explore some of the fieldwork of the forest. We moved in among the stark trees, their branches singing in the wind, and I recalled reading about the great white oaks that greeted settlers on this part of the Chesapeake and set them to shipbuilding. One account tells of the winter of 1852, when oxen tugged massive slabs of hewn oak across the frozen bay to a ship from Boston, blocked by ice. The chunks were headed for New England, to become the "knees"—the mighty brackets that support the decks—for the Yankee clippers of that era.

On this winter day—surely every bit as cold as that one in 1852—we trudged through frozen undergrowth beneath tall, fast-growing tulip poplars and sweet gums. I noted a tangle of old, heavy vines hanging from the tall trees, slatting the trunks like halyards at a winter mooring. Hines nodded toward

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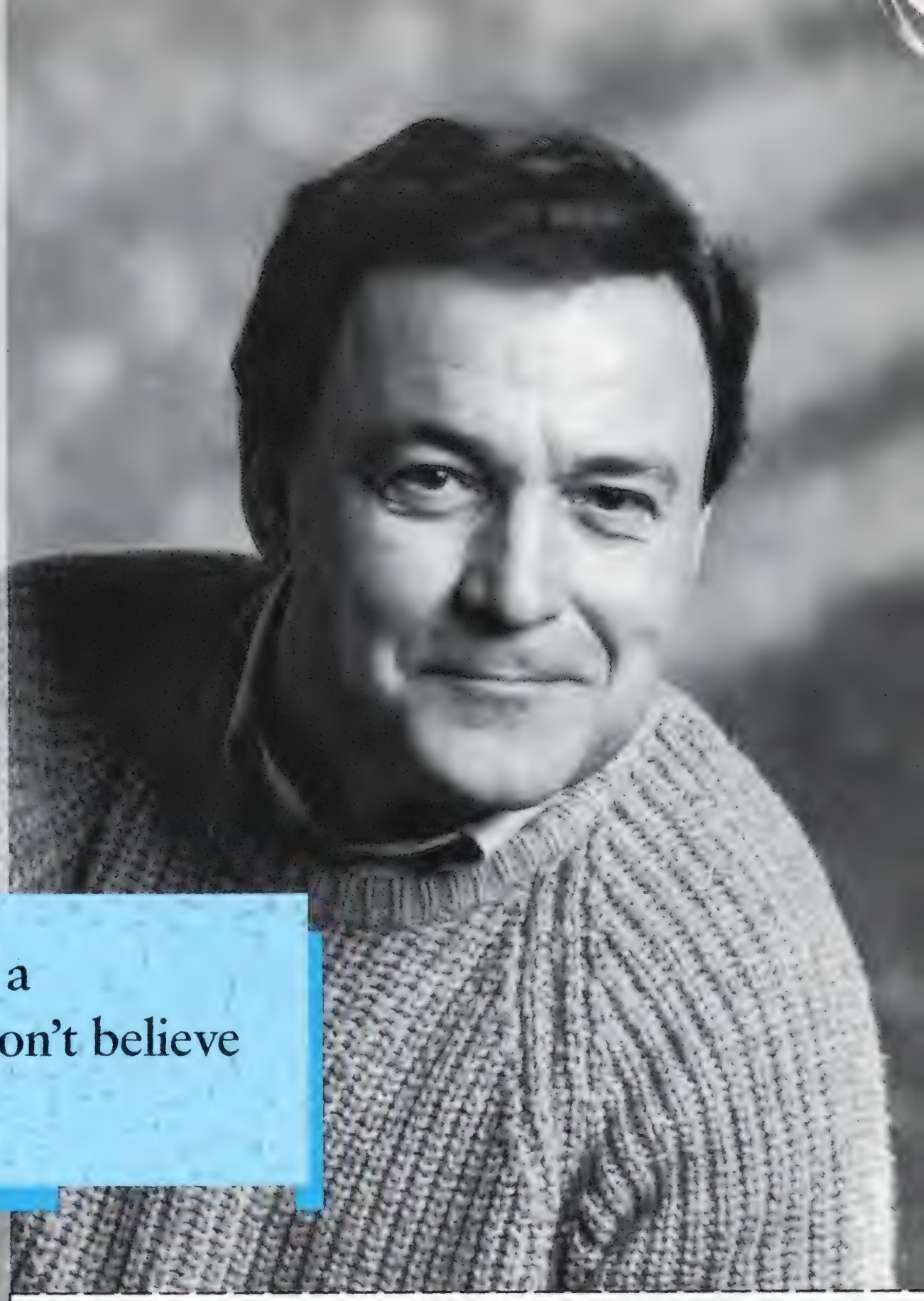

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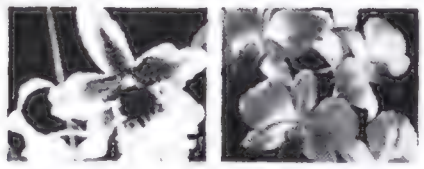

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a ropy monster, clinging grimly to a tree trunk. "That's poison ivy. It's hard to believe it started as just a little patch of underbrush."

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We passed through Tarzan country and into mature forest: beech, hickory—and I greeted with deference some of those old shipbuilding white oaks. No vines here; they never get started. We paused to investigate a V-notched weir built down through the mud to a hard base of dense clay. This allows all the runoff—not just surface water—to flow through. It's sampled in the instrument shed that stands beside the weir. Readings are taken to the computer room where they are converted into data files.

Ahead of us a sprawl of snowy brush exploded into movement as a small herd of deer plunged off, white tails flashing. "There goes some of our wildlife," Hines called out. "And speaking of wildlife, look over there." He pointed to a forest opening, white with ice. "Beaver pond," I blurted, recalling my youth in northern New England. Hines gave me an approving glance, and I tried not to smirk. "They just got established here," he said. "The backwater created by their dam will kill some trees, but the amount of sediment here will probably slack off because so much of it will become silt in the pond. Anyway, it's good to have them."

Walking on, I spotted a tall tower, built like a slender scaffold of metal strips, that probed to the tops of the wind-whipped trees. There is a similar tower at the Smithsonian Tropical Research Institute on Barro Colorado Island in Panama, where scientists use it to study the canopy of the rain forest. I climbed it once (because, like Mount Everest, it was there), and found it fascinating and terrifying. Now I was confronted with its double—a 156-foot structure, put together, it seemed, like an Erector set. "You must come and climb it," said Hines. "But not today."

"OK," I agreed.

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(dust and particles from the air and leaves) and the wet fall (which is wet fall). Near the tower, which I shall try to find further excuses not to climb, is a plot of forest where every tree is tagged and mapped. "When one falls, we'll know which one and presumably see why it fell," Hines explained. "We can also perch on that little stand over there to watch the seed predators—birds, squirrels, mice—in action."

Hines is doing research on the blue crabs of the Chesapeake and was anxious to show me his own procedures. He led me to a bluff overlooking Muddy Creek, a well-named tributary of the Rhode River, where the Smithsonian has built a fish weir. Balancing on single planks above the mud, we eased our way out to it, and he showed me how one section of the weir can be swung open by rope to allow small boats and canoes to pass through.

Hines said that one of the initiation rites for student interns was to take them over the mud in a boat and tell them to get out. "They always ask how deep it is, and we always ask them how tall they are." After thinking about that, I elicited the information that the "4-foot" pilings that hold up the weir are actually 20-footers that were pushed down into the mud by the force of body weight alone.

About 35 species of fish use the creek, some spending their entire lives here. Hines said that some are quite rare, some have become extinct. "We used to see yellow perch here, but no more. We think acid rain's to blame."

The crabs go up the creek to molt—about 10,000 of them a year. Hines has a very clear picture of their life cycle because he monitors it electronically. He had already shown me in his lab how he fits a small transmitter onto a crab shell. This sends out a high-frequency signal underwater that hydrophones can pick up. "We can follow a specific crab to learn where it feeds. And we can check the activity of its jaws. The number of bites it takes indicates the size of its prey."

Another tiny electronic device fits across the opening of the shell. When the two halves separate during the molt, the connection is broken and the exact time is recorded. The transmitter keeps on beeping, so Hines knows *where* as well as *when* molting occurred.

Hines has learned considerably more about crabs than they know themselves. They like clams, and they know when to go after them. They fall prey to herons and fish and mostly to other crabs.

Among several outreach programs devised by the Center's Mark Haddon is a Muddy Creek canoe trip that starts from a small dock a short walk from the main building—three people to a canoe, six canoes, 17 visitors in all, led by a staff member or docent. Children must be at least 8 years old.

Participants paddle upstream to the Forks, where two branches of Muddy Creek come together in a low marsh. Then they head back downstream to Frog Canyon, where a meander of the creek has cut away the bank on one side. They glide past a sampling station, where staff scientists and technicians use a little improvised pushcart railway to get out into the marsh with their equipment. In this way they minimize the impact on the grasses.

The canoeists open the weir and enter the broad mud flats, rich in life. Everywhere on the route there is abundant life—muskrats, herons, marsh wrens and red-winged blackbirds—among the *Phragmites*, the common reed grass. But not on our day. This was not the season for canoes. Instead, we tried Discovery Trail, a self-guided nature hike leading eventually to a boardwalk that crosses the marsh to Hog Island. Gusts tugged at us as we walked the planks above the frozen fen.

Hog Island has remarkably undisturbed forest. Looking out toward the Rhode River we saw whistling swans clustered in a pool of open water. Canvasbacks flew overhead, and narrow-leaved cattail rattled with ice.

Unless you really hate nature, you'll find Discovery Trail to be a mile and a half of great joy. It's open to everyone weekdays from 9 A.M. to 4 P.M. On weekends, you need to schedule your visit in advance and pick up a volunteer guide at the Visitors Center.

Construction on a new trail is set to begin this spring. The Java History Trail, named for the farm that raised dairy cattle here, will lead you past different areas where humans—Indians, Colonials, antebellum farmers—made their living off the land and left their marks on it.

I'll be back for that trail. No more ten-year gaps in my visits to SERC.

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Phenomena, comment and notes

The night sky and our sense of where we are in the cosmos are being lost in the glare of wasted light on Earth

Looking at the night sky is like going birding: every year there is less to see. Unlike warblers and vireos, the stars are not actually disappearing; rather we are slowly being blinded. Those points of light are still out there—we just can't see them. Textbooks still say 6,000 stars are visible to the unaided human eye. The Milky Way is portrayed on sky maps as a prominent feature, as though the reality were a fine spray of white on black. For most of us, that's history.

The air we look through is a thin soup of water vapor and aeroplankton, dust and hydrocarbons. But it is not air pollution that blocks our vision: instead the light coming to us from near and far corners of our galaxy is overwhelmed by the light we generate ourselves. Our own nighttime illumination is blinding us to the light of the cosmos.

"Deep-space" astronomers, those patient souls striving to see to the edge of the Universe and back to the beginning of time, are hurt the most. They are trying to see objects so dim, so far away, that at times their instruments are counting individual photons that have been crossing the intergalactic darkness for most of the lifetime of the Universe. It so happens that we just now are discovering things about the structure of the Universe as revolutionary as our realization early in this century that our home galaxy is just one of innumerable island universes. We have found great voids in what had seemed the random, even distribution of galaxies. Then we found that galaxies cluster on the perimeters of these voids, forming a "soap-bubble" universe. Now we are seeing a "great wall" of galaxies, the largest structure ever seen—or imagined, for that matter. The discoveries are coming thick and fast, and all the while our great telescopes are in effect becoming smaller and smaller.

David L. Crawford is an astronomer at the Kitt Peak National Observatory near Tucson, Arizona. Also a leader in the campaign to protect observatories from light pollution, he is both chairman of an International Astronomical Union (IAU) colloquium on the subject and founder and driving force of the new International Dark-Sky Association. He describes the latter as a "nighttime Sierra Club—but not radical." Crawford estimates that the 200-inch Hale telescope on Mount Palomar in Southern California has been reduced to a 139-inch instrument by the encroaching lights of San Diego County. Even the telescopes in the high desert of Chile are losing their power, Crawford says, to the lights of growing La Serena, 50 miles away.

For amateur astronomers, the problem is just as real. Consider the catalog of Charles Messier, called "the Comet Ferret" by King Louis XV for his discovery of a score of the ethereal interlopers from a rooftop tower in Paris two centuries ago. To save himself time wasted on comet look-alikes, he put together a list of fuzzy objects in the sky, most of which we now know to be globular star clusters, patches of glowing gas and other galaxies. Other observers added to the list. Today amateurs like to work their way through the catalog: there is a club for those who have found all 110 Messier objects.

It is no simple task. A colleague here at the magazine has carried his 8-inch telescope to parks and beaches, the darkest places within easy reach, in a yearlong hunt for the Messier objects. Even with equipment to aim his telescope at the precise location of a given object, he found that some were almost impossible to see. Yet his reflector has three times the light-gathering power of the instrument Messier used in the heart of a capital city.

Astronomers are not the only losers through what Crawford calls the "trashing of our night environment." In his introductory talk to the IAU colloquium, he argued:

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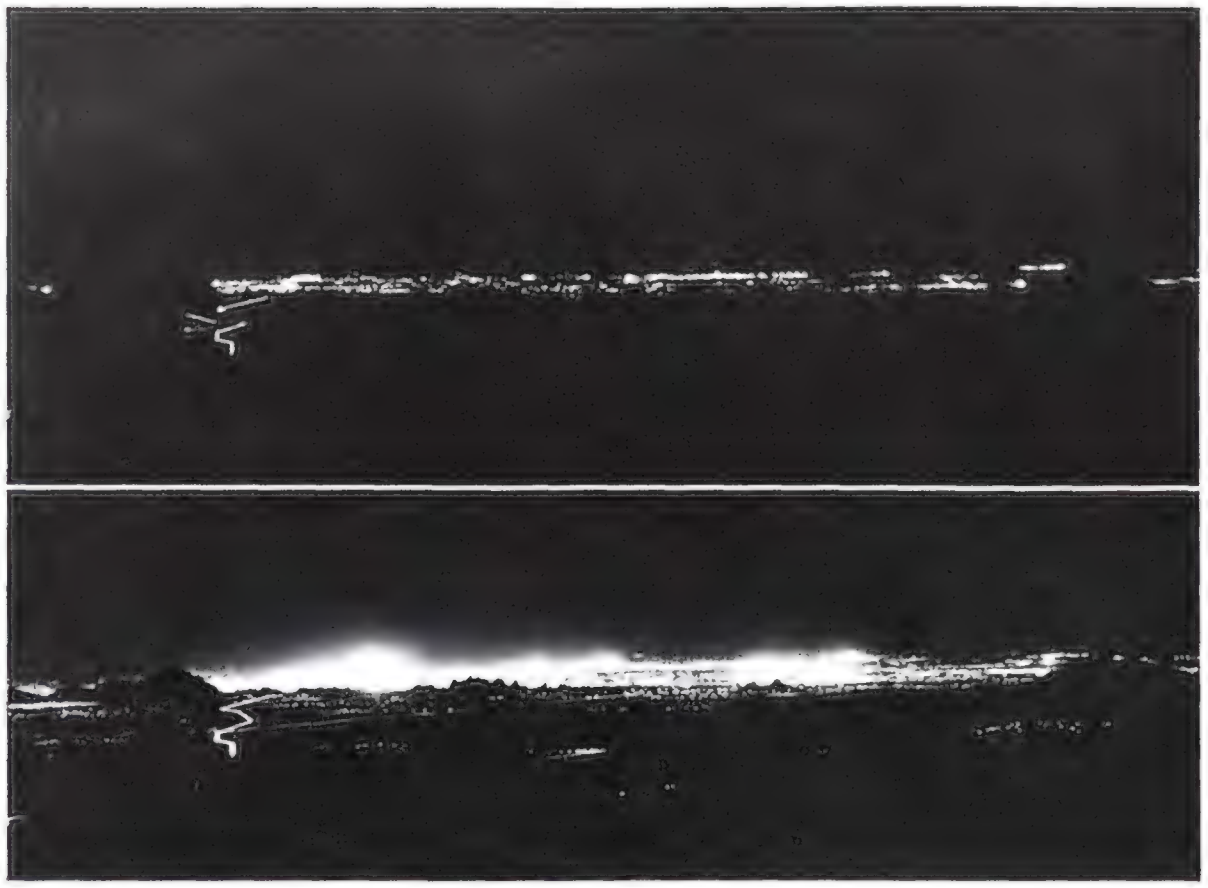

The lights of Tucson have steadily encroached on the telescopes of Kitt Peak, as seen in photographs taken in 1959 (top) and 1980.

worth protecting even without astronomy. Such a view, from a prime dark site, is one of nature's most wonderful marvels. Few have seen such a view and not been deeply impressed. Face it, astronomy is a philosophy and an art as well as a science. Considerations of the Universe, what it is, what it means, what's out there, are fundamental. Without the view of the Universe, these are lost. And, if lost, mankind's sensitivity to the Universe and the environment will continue to decline."

Crawford believes that, in general, things will only get worse. "The impact will be most severe, of course, on future generations. They will face the specter of not ever seeing the Universe 'live,' but only on a planetarium screen or on TV. In fact, that is the only way that many now see nature—on TV. There is no question in my mind that this lack of sensitivity to the environment is at the root of mankind's apparent effort to destroy that environment, taking all species, including mankind, down as well."

For the professionals, some of the news is good. Ordinances to control outdoor lighting have been enacted in Arizona, Southern California and other parts of the country. San Diego recently switched over from high-pressure sodium lamps, which ruin spectroscopic observations, to low-pressure sodium, which does not. The city, incidentally, will save $3 million a year, Crawford points out.

The worst problem is outdoor lighting: sports stadiums, auto dealerships and lights aimed upward at billboards. At least 30 percent of this light misses its target and is wasted. Or, as Crawford puts it, the United States spends a billion dollars a year "lighting up the underbelly of airplanes." Translated, that sum comes to 6 million tons of coal or 23 million barrels of oil.

The solutions are as simple as using fixtures that direct all of their light downward or directly at the target, choosing sodium over mercury lamps, installing timers that shut lights off after midnight when few people will see what is being illuminated. It means saving money, stretching resources, alleviating air pollution. It even means a break for wild creatures disrupted by lights, whether they be moths pollinating night-blooming flowers, birds migrating or sea turtles looking for a beach to lay their eggs. For those who care to relish the cosmos, it means reclaiming the night. As Crawford says, cutting down on light pollution is a win-win situation.

We are not all county commissioners busy buying streetlights and passing ordinances. But we do have access to light switches. And all the light escaping our homes adds to the loom in the sky. One

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little light does not seem like much until you spend some late-night hours in the backyard, maneuvering around the tube of a trusty six-inch reflector. Then the sudden switching on of a bathroom light nearby is like a floodlight coming on. Night vision, which took 20 minutes to acquire, is gone in an instant. And you start to think about all the lights burning in empty rooms.

Thinking about these things brought on old urges, so one night in late February I left work well after dark to see for myself. All day a 20-mile-per-hour wind from the northwest had been bringing clean air down from Canada (never mind what a southwest wind sends up there); the sunset had been cloudless. The waning moon was all the way around to Sagittarius in the morning sky. The night would be as good as it gets for stargazing.

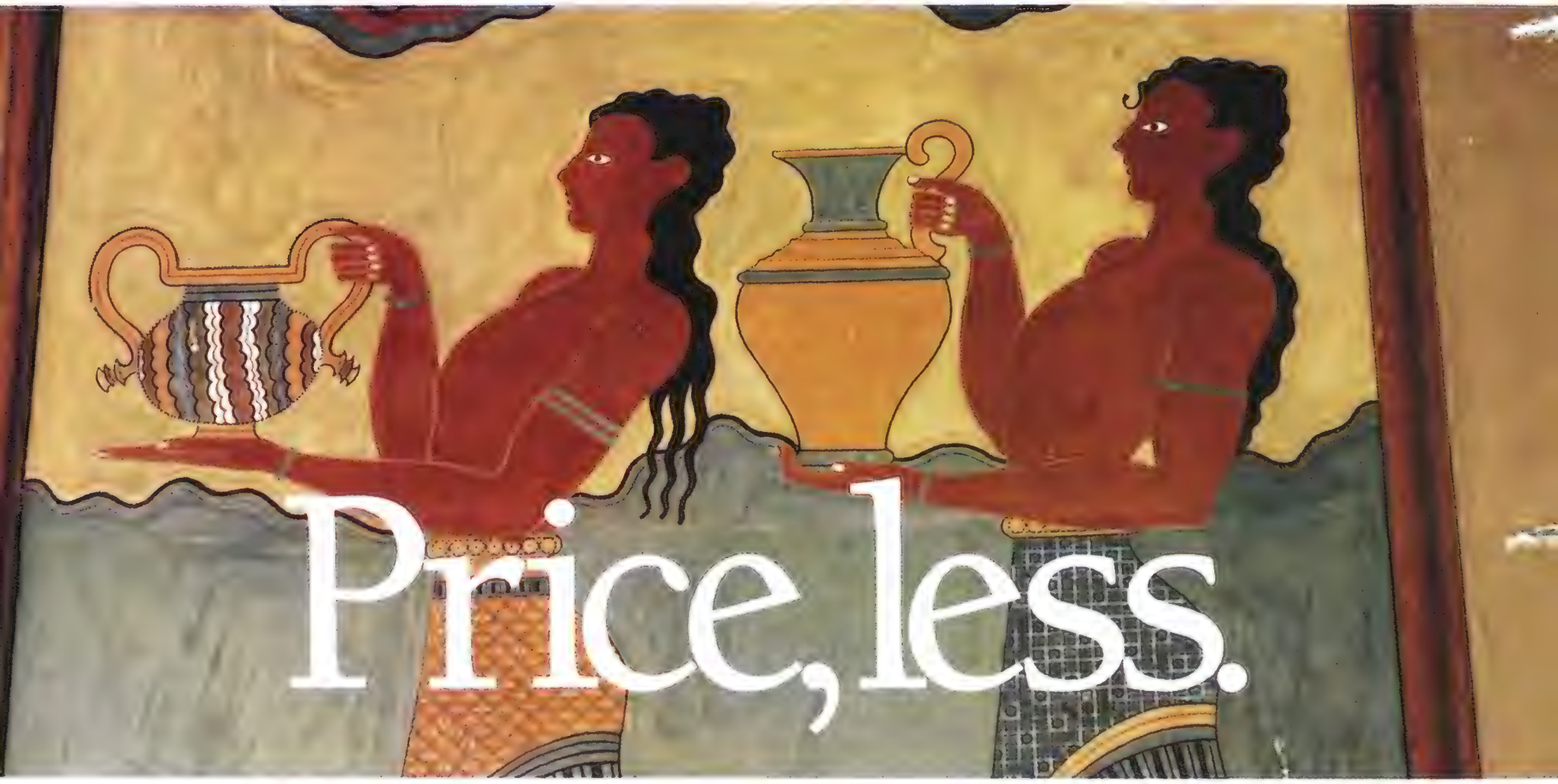
Down the Mall I went, past the joggers and the homeless wrapped in blankets. Up the hill to the Washington Monument and down the other side into a dark area that faces the Reflecting Pool and, six blocks west, the Lincoln Memorial. The air was so clear that I could follow for miles the lights of planes climbing north out of National Airport.

Above, Jupiter burned near the zenith. Orion the hunter bestrode the meridian, followed by his faithful dogs with their bright stars, Sirius and Procyon. The Gemini twins, Castor and Pollux, rode higher in the sky. And that was about it. The three stars of Orion's belt were easy to see, but those of the sword were at the limit of visibility; the fuzzy patch of nebulosity, M42 in the Messier catalog and now known to be a region where stars are forming, was quite invisible, although it is considered a naked-eye object. Aldebaran, the red eye of Taurus the bull, was easy, but I could see only three of the Seven Sisters, the Pleiades. To the northwest other stars forming the squashed "W" of Cassiopeia were just visible, but there was no sign of the Milky Way that spills over it. It took me a long time to find the North Star. My *Sky & Telescope* star map showed that the Andromeda galaxy (M31) was still well above the horizon in the northwest, but there was no sign of any of the stars that might have led me to it. In the language of ecology, this was a depauperate sky.

It is more and more the case that birders have to travel to see birds that once were common. The same holds even more so for amateur astronomers—or anyone who wants simply to see the individual suns that pull our eyes and minds deeper and deeper into space, and the broad band of light that marks the great wheel of the Milky Way, our galactic home. Nowadays (nowanights?) it means either driving out of town just to look up or waiting for those increasingly rare occasions when our travel on other business serendipitously presents us with a dark sky. Resorts in the Southwest now advertise their night views to frustrated astronomers in other parts of the country: they are selling what used to be free.

Crawford's "win-win" argument makes sense. If the flip of a switch can save us money, lessen the poisoning of the air we breathe, help one wild creature make it through the night and give us back a glimpse of what Messier saw, it would seem worth considering.

John P. Wiley jr.



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A Special Issue on the Environment

They closed down Fifth Avenue in New York, attended eco-fairs in Chicago and staged "teach-ins" and "trash-ins" all across the country. More than 20 million Americans showed up for what turned out to be the launching of the modern environmental movement. It was Earth Day, an extraordinary "happening" that occurred exactly 20 years ago, on April 22, 1970. For the first time, the nation woke up to the fact that degradation of the natural world threatened not only the quality of life but its very foundations.

There was, as it happened, another launching that month. It didn't attract as much attention as Earth Day, but it nevertheless put into orbit an enterprise that, like the environmental movement itself, is still going strong. The first issue of this magazine, Volume 1, Number 1, was published exactly 20 years ago, too.

The idea behind SMITHSONIAN was and is to explore and reflect whatever the Smithsonian Institution is interested in. That covers a lot of ground, but from the very beginning we've maintained a special commitment to the subjects we regard almost as kin—natural history, ecology and conservation. Take our first issue. It featured a pair of courting elephants on the cover. Inside, there was a long essay on Man and the environment, together with articles on starfish, overpopulation and a new endangered-species breeding program. That's pretty much the way it went from then on, issue in and issue out, year after year. Whether it was the destruction of a scenic lake in California or the construction of a pipeline across the Alaskan tundra, whether it concerned the plight of the leopard in Africa, the polar bear in Canada or the wild horse in the American West, SMITHSONIAN kept its readers informed about what was happening to their world.

We're still at it.

To commemorate Earth Day's anniversary and the magazine's birthday, we're devoting this special issue entirely to the subject of the environment. The articles deal mainly with events here in the United States: domestic issues were the focus of the original Earth Day, and this two-decade benchmark seems a good moment to step back and see where we stand. Have you ever wondered, for example, how we *got* to Earth Day in the first place? More to the point, what's really been accomplished, in practical terms, since then? As we begin the last decade of the 20th century, where's the environmental movement headed? What are the new frontiers and who will lead us toward them?

A consideration of these questions, as well as a series of reports on some other fascinating pieces of the puzzle, begins on the next page. Weighing this material in the balance against the dire warnings of the more pessimistic experts in our midst, it does not seem unreasonable to assert that all three of the following statements are probably true.

- We are making progress. The country is better off than it would have been without the movement Earth Day inspired.
- We are falling behind. The problems the world faces—overpopulation, global warming, desertification and the rest—seem to be outstripping civilization's capacity to deal with them.
- Technical fixes and business-as-usual have long since ceased to be enough. Man, a part of the natural world, must learn at last to live in harmony with it. Hence, the new buzzword: sustainability.

As envisioned by environmentalists, a sustainable society is one whose demands upon the Earth in no way diminish the lives of future generations. Can we do what has to be done to create one? If we are able to achieve as much on a global scale in the next 20 years as has been done here in the United States during the past 20, there's a good chance that we can. We're not talking, after all, about Utopia; we're talking about common sense.

THE EDITORS

By Wallace Stegner

It all began with conservation

Our first response to the New World's wild Eden was to break it—but seeds of a land ethic were planted early on

Values, both those that we approve and those that we don't, have roots as deep as creosote rings, and live as long, and grow as slowly. Every action is an idea before it is an action, and perhaps a feeling before it is an idea, and every idea rests upon other ideas that have preceded it in time. The modern environmental movement, though it has shifted its emphasis from preservation of precious resources to the control of pollution caused by our industrial and agricultural practices, declares our dependence on the Earth and our responsibility to it, and thus derives pretty directly from the 19th-century travelers, philosophers, artists, writers, divines, natural historians and what *Time* has called "upper-class bird-watchers" whose purpose was to know it, celebrate it, and savor its beauty and rightness.

Yes, Virginia, there was an environmental movement before Earth Day, a long, slow revolution in values of which contemporary environmentalism is a consequence and a continuation. We are still in transition from the notion of Man as master of Earth to the notion of Man as a part of it.

Our sanction to be a weed species living at the expense of every other species and of Earth itself can be found in the injunction God gave to newly created Adam and Eve in Genesis 1:28: "Be fruitful, and multiply, and replenish the earth, and subdue it." But what we are working toward, what with luck we may eventually attain to, is an outlook that was frequently and sometimes eloquently expressed by the first inhabitants of this continent. The Indians stressed the web of life, the interconnectedness of land and man and creature. Chief Luther Standing Bear of the Oglala Sioux put it this way: "Only to the white man was nature a wilderness and only to him was the land 'infested' with 'wild' animals and 'savage' people. To us it was tame. Earth was bountiful and we were surrounded with the blessings of the Great Mystery."

The New World was such a blinding opportunity to Europeans, and lay there so temptingly, like an unlocked treasure house with the watchman sleeping, that nobody thought of limits, nobody thought of preservation, until generations of living in America and "breaking" its wilderness had taught us to know it, and knowing it had taught us to love it, and loving it had taught us to question what we were doing to it. All of that is the background of the environmental movement.

It took us 200 years from Jamestown and Plymouth Rock to Americanize our perceptions, loyalties, vocabulary and palette so that we could see America clearly, and take pride in it. New ideas from Europe, especially the interest in nature that came with the Romantic movement, helped that pride along. But what made America the natural garden of those ideas, what most metamorphosed Europeans into something new, was what Europe had long lost and what America was made of: wilderness.

The 17th-century settlers did not look on wilderness with the eyes of a 1990 Sierra Club backpacker. Our wilderness is safe, theirs was not. Ours is islands in a tamed continent, theirs was one vast wild, totally unknown, prowled by God-knew-what wild beasts and wild men. In New England they also feared it as the trysting place of witches and devils. Even without devils, the struggle to survive fully occupied the first generation or two, and survival meant, in God's word, "subduing" the wild Earth. Nobody questioned the value of that effort. Civilization was a good; wilderness was what had to be subdued to create the human habitations that looked like progress and triumph even when they were only huts in a stump field.

Illustration series by Suzanne Duranceau

Metropolitan Museum of Art

Thomas Cole's *Oxbow*, painted in 1836, suggests the ambivalence that most Americans felt about the land.

To the boosters, America was always "prosperous" farms, "smiling" villages, "bustling" towns. But life on the frontier was more often crude and brutal and deprived. Crèvecoeur, in his *Letters from an American Farmer* (1782), painted a rosy picture of the established farm and the self-reliant industrious farmer; but he had to admit that out on the edge, beyond the settlements, were surly, verminous men who lived in dirt-floored cabins with slattern wives and broods of dirty children, sustaining themselves by constant killing of animals and growing ever gloomier and more antisocial by the eating of wild meat. Crèvecoeur thought that as settlement caught up with them they would gradually grow out of their barbarous stage and join the ranks of the happy, prosperous and civilized.

Maybe some of them did. Maybe some just went farther west when the settlements caught up. No matter which they did, the frontiersman was being built by the popular imagination into an idealized archetypal figure, divorced from Europe, divorced from history, homegrown, a demigod in buckskin. His real-life prototype was Daniel Boone. His larger-than-life fictional version was James Fenimore Cooper's Natty Bumppo, "Leatherstocking," who appeared in the novel *The Pioneers* in 1823 and whose story continued on in other novels into the 1840s.

Leatherstocking is everything that any American boy ever dreamed of being. Far from handsome (looks went with the effete and civilized), he is nevertheless fearless, self-reliant, omnicompetent, a keen tracker and a dead shot, a mortal enemy and the most loyal of friends. He is also the soul of chivalry, protecting and saving Cooper's females when they go implausibly astray in the wild woods. An orphan, untutored, Natty has kept the innocence of the natural man. From his brief contact with the Moravians, or from the woods themselves, he has imbibed a noble magnanimity, a sensitivity to beauty and a deep if unorthodox piety. Homeless in the civilized sense, he has made the wilderness his home, and no witches, devils or fears assail him there: he feels the presence of God in every leaf. There is not a trace in him of the overcivilized fastidiousness that in the 18th century could lead the French novelist Mme. de Staël to draw the curtains of her carriage, so as not to see the unkempt scenery. Natty glories in the scenery of his woods and mountains, the wilder the better.

But what makes the Leatherstocking Tales significant for this review is that Cooper reveals an ambivalence that will become more common as the 19th

Novelist and historian Wallace Stegner, winner of the Pulitzer Prize and the National Book Award, has long been an eloquent voice for conservation.

Wild country on the left is magnificent but fearsome; the rural landscape at right is invitingly serene.

century careens on, and that is basic to much later environmental thinking. Civilization, on whose side Cooper felt obliged to be, was at war with the wilderness, which he loved. The carriers of civilization in Cooper's novels, the settlers, are often as uncouth and repulsive as they were to Crèvecoeur, and they destroy the beauty and liberty and bounty of the woods.

The same townsmen who throw Natty Bumppo into jail for shooting a deer out of season fire into a passing flock of passenger pigeons with every weapon in town, even cannon, and strew the earth with mutilated flesh and feathers. Wilderness man cannot live with settlement man. Like Daniel Boone when he felt too many people nearby, Natty goes on west, and Cooper's sympathy as well as the reader's goes with him. The destructive practices of settlement, which Cooper was among the first to lament ("What will the axemen do, when they have cut their way from sea to sea?"), are only a step behind.

Emerson, like Natty Bumppo, saw God in every manifestation of nature, but he was hardly a forerunner of environmental thinking. He declared America's intellectual independence of Europe, and he cheered the rocky, gritty American character that he saw forming on the frontiers, but he was too much enamored of American self-reliance and energy to fear any consequences; and though he professed a liking for the wild, it was for the wild of the Hudson River School paintings, in which wilderness is the backdrop for a foreground of homely husbandry—a farmer's cottage, a fisherman, a herd wading a stream, a rude mill. The Philosophers' Camp in the Adirondacks where he and fellow spirits gathered to take walks and hone the art of conversation was wild enough. It was otherwise with his somewhat prickly protégé, Thoreau.

From Walden the compass pointed west

For Thoreau, wildness was a passion. "In wildness is the preservation of the world," he wrote, and meant it. Repudiating his countrymen's concerns—progress, betterment, accumulation—and their predatory habits in the wild, he made his most characteristic gesture by building a shack on Walden Pond and living in it in most spartan circumstances for two years. One cannot imagine him as a hunter; he thought every creature was better alive than dead. He loved and studied, not always accurately but devotedly, the creatures of the woods and rivers and ponds around Concord, Massachusetts. From a rustic American base, he strove to look to the edges of the known world, and beyond. Though his life could have been illustrated by the half-tamed, half-wild landscapes of the Hudson River painters, his imagination could not. It demanded the utterly wild, free scenes of a Bierstadt or a Moran.

Thoreau never personally sought the wilderness. His only excursions into really wild country were his expeditions into the northern woods. As he said, he had traveled extensively in Concord. Nevertheless Thoreau was at one with Emerson in turning his back on the Old World. Even in an afternoon ramble, he said, the needle always settled west. He must walk toward Oregon, not Europe.

In Thoreau there is virtually every idea that later became gospel to the environmental movement, but it is there only as idea, not as action or call to action—unless withdrawal is action. He was not much of a believer in government, and he was the total opposite of a joiner. American as he was, wilderness-lover as he was, he was not a conservationist or environmentalist in our sense. Nevertheless, as the painter George Catlin had anticipated the national park idea by suggesting a

wild prairie reservation, so Thoreau anticipated the more modest urban-open-space idea by suggesting that every community should have its patch of woods where people could refresh themselves. His notion of nature as having healing powers has now the force of revealed truth. And the form of Thoreau's essays—rumination hung upon the framework of an outdoor excursion—has influenced virtually every nature writer since, from Burroughs and Muir to Wendell Berry, Edward Abbey and Barry Lopez.

Unlike Emerson, Thoreau was not one to search for God or the Oversoul in every natural object, but one senses that he was feeling his way toward an identification with nature not too far from that of the Indians. Yet Thoreau did not develop the concept of the web, the connectedness of all life. The man who did that was George Perkins Marsh.

Marsh was an extraordinary polymath, an architect, linguist, politician, diplomat and the first man to work backward, by the aid of history and science and observation, to the point of view that primitives know simply by participation. He was an authority on the Icelandic sagas and on Norse explorations. He served as congressman from Vermont and in this capacity was one of the main proponents of using James Smithson's bequest to create the institution that bears his name. He was Minister to Turkey, and for 21 years Minister Plenipotentiary to Italy. All of those real distinctions are now forgotten. What remains is a single book, first published in 1864 as *Man and Nature*, and reissued in revised form in 1874 as *The Earth as Modified by Human Action*. It was the rudest kick in the face that American initiative, optimism and carelessness had yet received.

Marsh and "the dangers of imprudence"

Growing up in cutover Vermont, Marsh had observed what deforestation did to streams, fish, birds, animals, the land; and serving for many years in the Mediterranean basin and the Fertile Crescent, he had studied man-made deserts, the barren mountains of Greece, the ruins of once-great civilizations. He saw calamity coming to America, and wrote his book "to point out the dangers of imprudence and the necessity of caution in all operations which, on a large scale, interfere with the spontaneous arrangements of the organic or the inorganic world."

Deforestation meant far more than a future shortage of lumber; it meant potentially irrevocable damage to what we now call the ecosystem. "Man," Marsh wrote, "is everywhere a disturbing agent. Wherever he plants his foot, the harmonies of nature are turned to discords." The process was the more dangerous because its results were not always immediately apparent. In the last year of a destructive civil war that made any expenditure of resources seem justifiable, and on the brink of the rampant exploitation that would follow, Marsh spoke out against every ingrained American faith, including the faith in an inexhaustible continent. "It is certain that a desolation, like that which has overwhelmed many once beautiful and fertile regions of Europe, awaits an important part of the territory of the United States . . . unless prompt measures are taken to check the action of destructive causes already in operation."

The destructive causes were indeed in operation. Having skinned New England, the loggers were now skinning the Midwest at appalling speed. Within a single lifetime they deforested an area the size of Europe. The pineries of Minnesota and Wisconsin

Amon Carter Museum, Fort Worth

Albert Bierstadt did panoramic *Sunrise, Yosemite Valley* some thirty years after Cole painted *Oxbow*.

were going down the Mississippi as huge lumber rafts. By 1897 the sawmills of Michigan would have processed 160 billion board feet of white pine, and left no more than 6 billion standing in the whole state.

It was like a feeding frenzy of sharks. There has been nothing like it since except the current destruction of the Amazon rain forest. Predictably, Marsh's warnings went unheeded except by a concerned few, upper-class bird-watchers probably, the kind who are generally well ahead of the mass public in these matters. Concerned about the destruction of the forests before reading Marsh, they were doubly concerned afterward, and in 1875 a group of them formed the American Forestry Association with the hope of influencing public opinion and perhaps legislation. Sixteen long years later, when the Michigan pineries were obviously nearing the end of their road, the public indignation that had inspired the formation of the AFA got a rider added to the General Revision Act, authorizing the President to establish "forest reserves on the Public Domain." Benjamin Harrison, and after him Grover Cleveland, and after him Theodore Roosevelt, took advantage of the law, and among them they put 43 million acres of forests, mainly in the West, out of the reach of the loggers. Then in 1907 angry Northwestern congressmen pushed through a bill rescinding the President's power to create forest reserves. With the help of his Chief Forester, Gifford Pinchot, Roosevelt named 21 new forests totaling 16 million acres, and *then* signed the bill that would have stopped him.

By then, Americans were romanticizing the wilderness, as Bierstadt did, rearranging the valley's features.

The tracing of ideas is a guessing game. We can't tell who first had an idea; we can only tell who first had it influentially, who formulated it in a striking way and left it in some form, poem or equation or picture, that others could stumble upon with the shock of recognition. The radical ideas that have been changing our attitudes toward our Earth habitat have been around forever. Only if they begin to win substantial public approval and give visible effects do they achieve a plain and even predictable curve of development. But once they reach that stage, they are as easy to trace as a gopher in a spring lawn.

Nearly every aspect of environmentalism since the founding of the AFA has demonstrated the same pattern: a charismatic and influential individual who discerns a problem and formulates a public concern; a group that forms itself around him or around his ideas, and exerts educational pressure on the public and political pressure on Congress; legislation that creates some new kind of reserve—national park, national forest, national monument, national wildlife sanctuary or wilderness area; and finally, an increasingly specific body of regulatory law for the protection of what has been set aside.

The impassioned campaign for wildlife

Virtually all conservation activity up to the mid-20th century was concerned with saving something precious in our national heritage. Thus, as Marsh, and later and more narrowly Gifford Pinchot, galvanized the impulse to protect what remained of our forests, so George Bird Grinnell, a hunting companion and boyhood friend of Theodore Roosevelt's, devoted his time and his magazine, *Forest and Stream*, to the protection of wildlife. He carried on an impassioned campaign against market hunters, poachers and women who wore feathers on their hats; and he and the Audubon societies (he founded the first one in 1886) can be credited not only with the Park Protection Act of 1894, forbidding hunting within the national parks, but also

Thomas Gilcrease Institute of American History and Art, Tulsa

Thomas Moran's paintings of splendors like *Tower Falls* helped get Yellowstone Park established in 1872.

with the first wildlife sanctuary, Pelican Island, which Roosevelt established in 1903. Wildlife protection came lamely and late—the passenger pigeon, Carolina parakeet and other species were gone, the buffalo and antelope were down to remnants, mainly in Yellowstone—but it did come, and those who made it come, by publicity and persistence, were an unlikely combination of bleeding hearts and gunners.

The creation of the first national park happened before this pattern of volunteer organizations working upon politicians had been perfected. It came about in 1872 because a party of Montana explorers had been so struck by the wonders of Yellowstone that they carried to Washington the demand that it be set aside as a public playground. F. V. Hayden's U.S. Geological and Geographical Survey of the Territories helped by laying before a dazzled Congress the paintings of Thomas Moran and Henry W. Elliott, and the photographs of William Henry Jackson, its expedition artists. Later it published, with 15 Moran chromoliths, a book that might have served as a model for the Sierra Club's coffee-table books, the first scenic art book with a political purpose.

That first national park was a spontaneous overflow of public enthusiasm. The following ones owed a great deal to a single man, John Muir, and to the organization he founded, the Sierra Club. Yosemite, Sequoia and General Grant national parks (the latter ultimately fused with Sequoia) were largely Muir's doing, as was the Petrified Forest. As John of the Mountains, the grizzled genius of Yosemite, he had entertained the great, among them Emerson and Theodore Roosevelt, on sublime hikes and long campfire talks, and because he knew the Sierra better than anyone, and was even more persuasive as a talker than as a writer, he got himself listened to. In 1892, two years after the Sierra parks were created, he formed the Sierra Club to look after their interests and enjoy their beauty. In 1905 he and the club finally persuaded California to cede back to the federal government Yosemite Valley itself, which had badly deteriorated under state control, so that it could become the heart of the park it belonged in.

"Use without impairment"

No story of the national park system would be complete without some mention of the Antiquities Act of 1906, passed because of the depredations of pothunters in archaeological sites in the Southwest. It authorized the President to set aside by proclamation sites that were especially precious or threatened. By 1916 there were 20 such national monuments, many of them scheduled to become national parks by later Congressional action. A quarter of all our present national parks owe their first reservation to the Antiquities Act.

By 1916 there were 13 national parks, crown jewels without an adequately stated purpose or an adequate keeper. Those that were managed at all were managed by the Army. But in that year the National Park Act gave these reserves their stated purpose, public enjoyment, public use *without impairment*, and created the National Park Service to carry it out.

Muir had a hand in the National Park Act, too, but only posthumously and as a result of his greatest failure. For years he and the Sierra Club had fought San Francisco's effort to dam the Hetch Hetchy Valley, which lay within Yosemite National Park and which Muir thought second in beauty only to Yosemite Valley itself. The effort enlisted public and newspaper support throughout the country. It also revealed a mortal split between conservationists of Pinchot's variety, who believed in "wise use" of resources, and preservationists like Muir, who believed that some natural things were too sacred to be exploited for profit, water, power or any other purpose.

In 1913, Congress voted to approve the dam. Within

a year, Muir was dead. But the feelings stirred up by the struggle did not subside, and perhaps there was even some guilt felt by people who had fought on the winning side. Three years after it voted for the Hetch Hetchy dam, Congress passed the National Park Act, with its guarantee that parks should indeed be what Muir and the Sierra Club had insisted they were: sacrosanct, to be enjoyed but not impaired.

That "use without impairment" clause was there when next the Sierra Club and its allies, this time under the leadership of David Brower, found themselves in a battle with dam builders. In the 1950s, as part of the Colorado River Storage Project, the Bureau of Reclamation proposed to build a dam within the section of Dinosaur National Monument in northeastern Utah. The case against the dam was not as strong as that against Hetch Hetchy, for Dinosaur was only a national monument, not a national park, and there had been damsite withholdings. Nevertheless, Dinosaur was part of the national park system, and that system was to be managed for use without impairment; nobody could deny that to drown a canyon under 400 feet of water would impair it. Ultimately it was the "use without impairment" clause that gave the conservation forces total victory. The Colorado River Storage Project was stalled unless that dam was removed from it, and it was.

Historians have concluded that the Dinosaur controversy marked the coming-of-age of conservation, the first time the diverse single-interest organizations joined together for strength, and proved they had a lot of it. But Dinosaur is not understandable without Hetch Hetchy. The tactics, the publicity campaigns, the political skirmishing, were similar in these instances. The difference between defeat in the first instance and victory in the second is that Muir did not have the National Park Act and the "use without impairment" clause to fight from, while Brower and his alliance did. And the precedent has been instructive in later struggles. Other laws, notably the Endangered Species Act, have similarly been used as barricades, and the snail darter and desert pupfish have been enlisted on the side of the environment.

The movement to save the last wilderness

If the national park idea is, as Lord Bryce suggested, the best idea America ever had, wilderness preservation is the highest refinement of that idea. Parks are designed for careful human use—they could be justified by a Pinchot. But wildernesses are something else. Preservation of wilderness implies agreement with Marsh's observation that wherever Man plants his foot, nature's harmonies are turned to discords. As the culminating aspect of the preservation sentiment, the wilderness movement differs from the park and forest and wildlife movements in its total repudiation of most kinds of human use. What it wants is the continuation of that healthy, natural web of life that Chief Standing Bear and others revered; and if there are human uses implicit in this long-range continuation—watershed protection, protection of genetic variety, the preservation of natural laboratories by which the deteriorating Man-managed world can be judged and perhaps saved—the *sentiment* for wilderness, our creature-love for the natural world, is probably as important. Like the other forms of land preservation, wilderness areas are doomed to be islands surrounded by what constantly threatens to invade and damage them, but that is what we get for learning slowly.

Wilderness has had its prophets, early and late; of the late ones, Aldo Leopold seems to me the greatest. It has developed its organization, the Wilderness Society, one of the most effective of the environmental groups. It has had its landmark legislation, the Wilderness Act of 1964, which authorized hands-off protection for areas carved out of the national forest, national park and Bureau of Land Management lands.

One thing wilderness has not lacked is enemies, for its nonutilitarian reserves are said to "lock up" re-

W. H. Jackson's photograph of Mammoth Hot Springs also spurred Congress to create Yellowstone Park.

Reproduced widely in books and magazines, Ansel Adams' powerful images of pristine landscapes played a key role in the rise of environmental consciousness. Here, Adams' *Redwoods, Bull Creek Flat, California.*

sources and frustrate our fabled American initiative. Not only resource interests but also incompatible recreationists and both the U.S. Forest Service and the BLM have dragged their heels in the process of wilderness designation. Some people learn late, some never do.

Ironically, wilderness preservation was born in that most utilitarian of organizations, Pinchot's Forest Service. It cropped up here and there like an ineradicable weed. In 1919 Arthur Carhart, a Forest Service architect in Denver, talked his employers out of civilizing Trappers Lake, in Colorado, with summer cottages. He later did the same thing in the boundary waters area of northern Minnesota. In 1924 Aldo Leopold, from the Albuquerque office of the Forest Service, got 900 roadless square miles of the Gila National Forest set aside as a primitive area. (He defined a "wilderness" as something big enough to absorb a two-week pack trip.) In a 1930 issue of *Scientific Monthly*, Robert Marshall, a plant physiologist working in Wyoming's Wind River Range, issued a ringing manifesto calling for identification and rescue of whatever wilderness areas remained. In 1934, after a conference in Knoxville, Tennessee, Marshall, Benton MacKaye and several other foresters determined that an organization should be formed to promote wilderness, and the following January, with Leopold and Robert Sterling Yard among the charter members, they formed it.

Their purpose was to replace the unreliable admin-

istrative designations of wilderness with wildernesses that were established by law, and hence impregnable.

Much of the program, as it developed, was the work of Marshall. The philosophical justifications, the statement of first principles, appeared in 1949 in Aldo Leopold's posthumous *A Sand County Almanac.*

In the 41 years since its publication, *A Sand County Almanac* has become a kind of holy book in environmental circles. It is a superb distillation of what many Americans had been groping toward for more than a century. Leopold loved land, all kinds, but the wilder the better, and over his lifetime of experience with land and its creatures he had come to look upon land as a community, not a commodity. Blessed with a poet's gift of words, trained in forestry, he brought as much sensitivity as Thoreau to his study of nature, and more science. His book comes to its climax in the essay called "The Land Ethic," in which he argues for the kind of responsibility in our land relations that civilized people are supposed to show in their human relations.

Without denying the human need to use natural resources—cut trees, plow prairies, shoot game, whatever—he wanted a portion of the land left wild, for ultimately all human endeavor has to come back to the wilderness for its justification and its new beginnings. He said he would hate to be young again without wild country to grow up in. And he was no lover of public recreation as usually practiced. Recreation could be as dangerous as logging or any extractive use. "Recreational development," he wrote, "is a job not of building roads into lovely country, but of building receptivity into the still unlovely human mind." Knowing how persistent the unloveliness of the human mind could be, he did not expect his land ethic to arrive soon. He perfectly understood that what he described would have its flowering far off, the product of a long, slow and almost total revolution of American values.

Fifteen years after the publication of *A Sand County Almanac,* and after the extraordinary effort of many people, politicians as well as environmentalists, and especially of Howard Zahniser, executive director of the Wilderness Society, Congress passed the Wilderness Bill. Tired of fighting brushfire wars after the Dinosaur struggle, Zahniser had drafted a bill in 1956. During the next eight years he revised it 66 times. When, after innumerable hearings and thousands of pages of testimony, it was finally passed, it still contained Zahniser's definition of wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain."

The passage of the Wilderness Bill, and its immediate designation of 9.1 million acres of wilderness in national park, national forest and wildlife refuge land, marked the climax of preservationist environmentalism. The wilderness designation process, clogged with controversy and sullen with turf battles among the bureaus, and shrilly resisted by resource interests, would go on—still goes on. But a corner had already been turned. Rachel Carson's *Silent Spring,* in 1962, had already made it plain that pollution, not preservation, was to be the principal concern of the future.

And so this is the long road the nation traveled to get to Earth Day 1970. Those who led us down it, the countless individuals and scores of organizations who resisted the lunchbucket and "American initiative" arguments of resource exploiters, did not leave us a bad legacy. Considering the mood in which the continent was settled, and the amount we had to learn, we can be grateful that those battles do not have to be fought, at least not on the same fields, again. We can be just as certain that others will have to be. Environmentalism or conservation or preservation, or whatever it should be called, is not a fact, and never has been. It is a job.

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MACHINE JAGUAR

By Bil Gilbert

Earth Day plus 20, and counting

By 1970, our air, land and water were a mess, and they're still in trouble today—but don't overlook progress we've made

Strictly construed, "environment" refers to everything everywhere, but the word and its derivatives are seldom employed in this sense. For example, few if any think of "environmentalist" as meaning a Renaissance sort with universal interests. In practice, such vague terms mean more or less what their users think they do. Therefore they must be individually defined to avoid confusion and deceit. To make a start, my understanding of "environmentalist" is based on the following observations and opinions.

In this country, environmentalists are—with all exceptions granted—commonly Caucasians who possess more than the average means, education and leisure, and are found in relatively attractive and comfortable circumstances. They are distinguished from others who share these attributes by a set of strongly held, fairly homogeneous convictions. They believe:

• The world is divided into two disparate, often conflicting spheres. One comprises humans and their works. Everything else is the "environment," or nature.

• The manner in which humans have encroached upon, despoiled and otherwise abused nature is the cause of virtually all environmental problems.

• Nevertheless, what is left of nature still operates so efficiently, is so beautiful and benign that any major changes in it will probably be for the worse. For example, it is estimated that there are between 10 million and 30 million species of plants and animals now living in this world. Environmentalists are convinced that this, whatever the exact number, is about how many there should be. If the total were to be substantially altered by, say, extinction, mutation or genetic engineering, the consequences would be catastrophic.

• With strong views about what nature and our relationship to it should be, environmentalists feel obliged to instruct the ignorant, inspire the apathetic and confront nonbelievers in regard to these matters. "Clearly, Man has become an unnatural force in the world," says Jay Hair, the president of the National Wildlife Federation, which with 5,600,000 members is the nation's largest environmental organization. "To be an environmentalist now, it is no longer enough to enjoy or study nature passively. We are activists engaged in promoting the wiser use and protection of our global natural resources."

There have been environmentalists among us since at least the Eisenhower era, which is when I began reporting on them and their concerns. However, there was not, or was not generally perceived to be, an environmental movement until about 1970. To the extent the origins of any complicated phenomenon can be traced to a single event, the first Earth Day happenings in the spring of that year were catalysts that transformed a fairly specialized interest into a pervasive, popular one.

Gaylord Nelson, then a U.S. senator from Wisconsin, is sometimes referred to as the father of Earth Day because he was instrumental in getting it off the ground. He's now counselor of the Wilderness Society. When we talked in his office recently about the circumstances and events of 20 years ago, he could recall only five other senators who were concerned with environmental issues in 1963, the year he began serving his first term in office. "The number increased somewhat in the next decade," he reflected. "But Earth Day—as was intended—demonstrated to the Washington Establishment and the public that there *was* an environmental movement. The principal and lasting effect was to make environmental concerns a permanent part of the political dialogue in this country. Obviously not all members of Congress are now what I would call en-

vironmentalists, but almost without exception they are sensitive to environmental issues—because they have to address them while campaigning—and they have at least one staff member who is knowledgeable about them."

Nelson's claims about the impact of the movement that Earth Day triggered are probably too narrow and modest. In the past two decades, environmental concerns have substantially changed, among other things, our habits of work, travel and play, our diets, dress and architecture. Many of these effects (more about some of them later) have been very material and quantifiable. But to my mind the most extraordinary accomplishment of environmentalists—and the one largely responsible for their present economic, social and political influence—has been essentially psychic. In a few decades they have radically altered the image of nature and the opinions that had popularly prevailed for many centuries about how society should treat it.

· According to ancient artifacts and records, people everywhere have almost always personified nature as female. She has been variously known as the Maker of Life itself, the passionate White Goddess, a nurturing mother and a vengeful hag. At times she could be magnificent, but the "grandeurs" of Nature, like the charms of a Valkyrie, were awesome and intimidating. Sophisticates and esthetes might venture forth to ogle her and commune with her briefly, but continued intimacy was apt to addle mortals and make them bestial. Whatever else she might be, Nature was always a brawny, powerful, strong-willed being, quick to punish those who showed impudence or disrespect. She worked in her own ways for purposes that sometimes proved contrary to the short-term ambitions of humans.

Bil Gilbert has been writing about conservation matters for more than 30 years. His profile of the badger appeared in the January 1990 issue.

In a symbolic gesture, a New York City student wore a gas mask to protest air pollution on Earth Day 1970.

The Nature that Europeans brought to North America had been fashioned by centuries of Christian theological investigation and sacerdotal science. She was as formidable as the pagan goddesses but more hostile—the savage mistress of the wicked wilderness; the evil witch-queen and implacable enemy of civilization, the spread of which was God's cherished design. Fences, highways, walls, cities and other works were thrown up to keep Nature at bay, but sometimes it was necessary to enter her domains because she also happened to be an immensely rich storekeeper. In this guise Nature was a jealous miser who guarded her hoard like a dragon. Needy men had to wrest what they could from her by trickery and force. Successes in doing so were

More than 20 million Americans took part in events to demonstrate their support for environmental action.

counted as "triumphs of Man over Nature" and as demonstrations of human industry and ingenuity.

The new, environmental-age Nature bears little resemblance to previous versions. She is a slight, frail being, prone to vapors, fainting fits and many other debilitating ailments. The new Nature is not so intimidating, does not have the sort of grandeur that the old one did, but she is still very beautiful, though now somewhat in the style of an anorexic fashion model. Also she is very good—much better than the old one—for people. In fact, there is a widespread conviction that frequent congress with Nature is the ultimate therapy for mortal bodies and souls; thus, natural foods, fibers, medicines, exercises and gardens.

The new Nature may be even richer than the old, but she is not strong enough or aggressive enough to defend her treasures against rapacious humans. Environmentalists find this passive Nature even more frightening than the combative ones of yore. Their basic premise is that unless we quickly mend our ways she will certainly become comatose and fade away. We will then not only be very sorry but also, in short order, defunct. Biochemist and biophysicist Jessica Tuchman Mathews, a former environmental adviser to President Jimmy Carter and a member of the National Security Council, is now a vice president of the World Resources Institute. Speaking in 1988 of the prospects of her 3-year-old son, she said: "If we are talking about 75 years from now and things don't change, I think he will inherit an unlivable planet."

A nation of environmentalists?

An anthology of recent opinion surveys gives some indication of the public's reaction to such warnings. The pollsters conclude that a majority—on most questions, a large one—of Americans believe that the poor quality of the environment is one of our most serious national problems, of more magnitude than, for example, homelessness and unemployment. If it will protect the environment, the majority favor, among other things, limiting economic development, changing consumptive habits, increasing government regulations and raising taxes. They say they will support politicians who support such measures.

All the environmentalists I know contend that these sentiments flow inevitably from reality; that they themselves have not been, in the usual manipulative sense, molders of opinion or imagemakers. Their role, they insist, has been only that of objective observers who have collected and passed along facts that led rational, public-spirited people to the inescapable conclusion that Nature can no longer protect herself against us, and therefore we must protect her against ourselves. Whatever or whoever is responsible, the defenseless image of the new Nature has, during the past 20 years, come to be generally accepted as a true one. In direct consequence, it seems to me, the environmental movement has prospered, and environmental works have multiplied at an astonishing rate.

With the possible exception of the abolitionists, no reform group in our history has used federal law so effectively—or created more of it—than environmentalists have. Though it was not immediately recognized, the first great legislative leap forward was made in the 1969-70 Congressional sessions. Galvanized by eco-disasters, such as the 1969 Santa Barbara oil spill, and attuned to the on-going Earth Day preparations, the staff of the late Senator Henry (Scoop) Jackson,

assisted by Indiana University professor Lynton K. Caldwell, wrote most of what became the National Environmental Protection Act (NEPA). A curious provision of it stated that before leaping into any development projects involving federal lands or funds, public agencies and private entrepreneurs would henceforth have to look at the likely environmental consequences. Environmental Impact Statements (the frequently despised EISes, as they came to be known) would be monitored by a newly created federal advisory body, the Council on Environmental Quality.

Since this council had no enforcement powers, the legislation was generally thought to be innocuous—essentially a statement of good principles on the order of those that speak well of mothers and apple pie. During the next few years, however, environmental activists took NEPA and ran with it to the courts. There, to summarize a number of cases, it was decreed that the EISes had to be substantial documents that considered such things as the effects of the planned works on soil, water, wildlife and recreation.

Once an EIS was completed, public agencies were expected to treat it seriously. An EIS had to be made available for public study and comment. As it turned out, this provision put some very sharp teeth in NEPA, since it gave environmentalists a chance to put intense pressure on agencies to respect EIS findings.

Initially, many public land managers and would-be private developers fiercely resisted the EIS process on the grounds that it was impractical, inconvenient and economically ruinous. After a number of adverse legal rulings, however, most of them concluded that NEPA was a slippery crevice that was best avoided by planning projects and filing EISes that did not bring down the wrath and lawyers of the environmentalists.

NEPA said: Look before you leap

NEPA revolutionized the federal natural-resource business, which is a very considerable one. In addition to overseeing highway construction, irrigation plans, flood control, erosion control, military projects and many other public works, federal agencies own nearly a third of the United States. These holdings include many of the nation's most valuable coal, oil, gas, hard mineral and grazing lands. Since 1971 very little has been done on any of them without some kind of environmental review.

Before the impact of NEPA was fully appreciated, Congress passed, without much technical study or debate, a number of other substantial pieces of pro-environmental legislation. The Endangered Species Act became law during, and generally with the approval of, the Nixon Administration. So did revisions of federal air and water legislation known as the Clean Air Act and the Clean Water Act. As Gaylord Nelson and others have observed, there were then not many true environmental believers in Congress and fewer still in the executive branch.

A local activist gave a thumbs-down to Pittsburgh's notorious smokestack pollution back in the mid-1970s.

In 1970 William Ruckelshaus, an assistant attorney general in the Justice Department, was appointed as the first head of the newly created Environmental Protection Agency. Looking back on that time recently, Ruckelshaus told me: "After about 90 days at EPA, I decided the laws we were expected to administer were poorly conceived and in many instances unworkable. Congress mandated that we do the impossible—create a permanently perfect environment."

In Ruckelshaus' opinion, unreasonable expectations about what the EPA—which is slated to receive full Cabinet status this year—could and should do inclined activists to blame the agency for all environmental imperfections. As a result, the environmental community has come to regard the EPA not as an ally—as, for example, the Commerce Department is regarded as an ally of the business community—but as a major federal enemy. This antagonism, Ruckelshaus thinks, has often curtailed support and funds for doable projects that could have alleviated, if not eliminated, many environmental problems.

The Endangered Species, Clean Air and Clean Water acts complemented and strengthened NEPA by increasing the number of natural phenomena and federal regulations that had to be considered by anyone preparing an EIS. A number of other statutes—for instance, the Resource Conservation and Recovery Act—were passed to require even more progress. Whatever

By now, thanks to an unusual partnership of private firms and public agencies, the city has cleaned up its act. The downtown skyline (above), which was often obscured by smog at midday, is notable for clear air.

else it has or has not done, this tough, interlocking mesh of law created what can be described as the environmental-protection industrial establishment, which has come to have a very direct, material impact on the lives of a sizable number of Americans and indirect influences on those of nearly everyone.

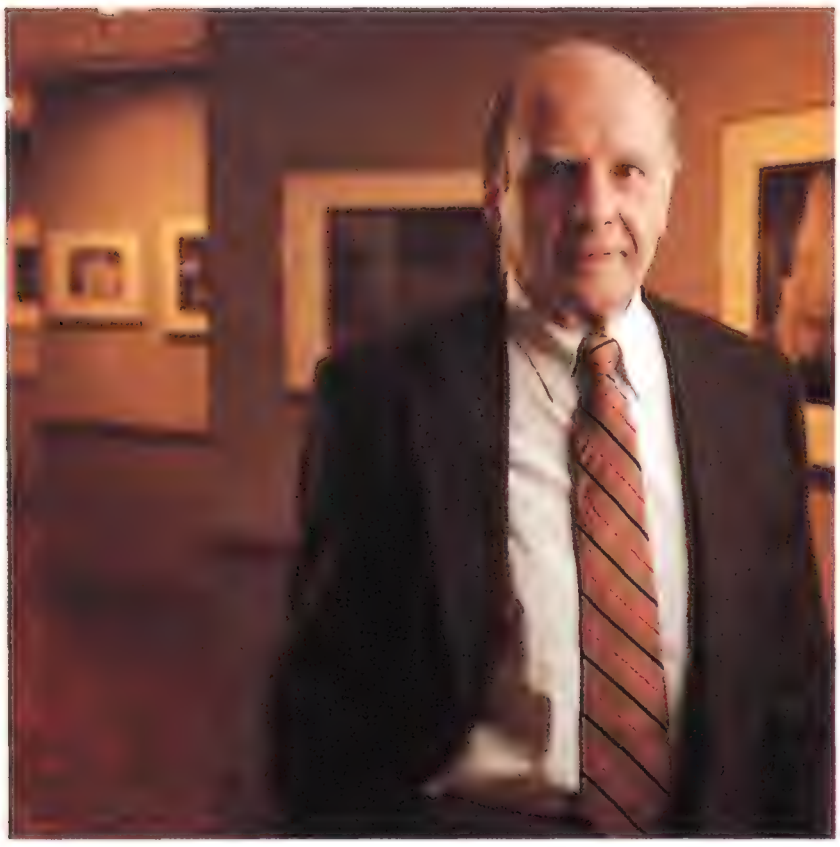
This enterprise has become so large and complex that it is difficult to quantify, but the EPA and other sources roughly estimate that public agencies and private firms are now spending about $100 billion a year on pollution control. A decade ago this figure was about $50 billion. All authorities who follow trends in this industry are certain that during the next decades it will grow at least as rapidly as it has in the past.

Environmental protectionists now work on many problems that were ignored or not recognized 20 years ago, and they try to solve them with strategies and devices that did not exist then. In consequence, the industry has created new trades and professions, particularly in the pollution-control and waste-disposal lines. It has also enlarged and upgraded opportunities in a number of traditional vocations. For example, the government agencies that administer EISes, and the private contractors that must abide by them, now employ biologists, ecologists and assorted other terrestrial, aquatic and atmospheric professionals.

The legal profession, which acted somewhat as a midwife at the birth of the environmental movement, has certainly benefited from its growth. Records and recollections are hazy, but there were probably only a few hundred attorneys specializing in this field in the 1960s. Today, there may be as many as 20,000. In 1971 a summary of federal environmental law in the *Environmental Law Reporter* occupied 33 pages. Last year the *ELR* published more than 3,500 pages to cover current developments in the field.

Another group of people whose lives surely would be much different if there were no environmental movement: the cadres who earn their keep and make their mark working for environmental organizations. The National Wildlife Federation annually publishes a directory of conservation-oriented groups. In 1975 there were approximately 200 of them, with a combined membership of 4 million. In 1990 there are 350 or so, with more than 12 million members. They range from Accord Associates ("founded to act as an intermediary in environmental disputes") to Zero Population Growth ("which works to achieve a balance among people, resources and environment by advocating population stabilization"). They vary greatly in size and resources, but I cannot think of any that do not now have more staff, publications and areas of concern than they did.

If the number of new environmental groups is impressive, the changes during the past 20 years in the older ones is more so. Many of the largest and most influential organizations were founded before anyone had heard or thought of an environmental movement. As their names—National Audubon Society, World Wildlife Fund, Izaak Walton League, the Nature Conservancy, the Wilderness Society—suggest, many were established principally as sporting, nature appreciation or nature preservation associations. The "new" environmentalists of 20 years ago spoke somewhat dispar-



Former senator Gaylord Nelson, who now works for a wilderness group, is called the father of Earth Day.

William Ruckelshaus, chairman of a waste-disposal firm, headed the Environmental Protection Agency.

agingly of the "old-line conservationists" and tended to mock them for having timid and excessively narrow interests. However, not a few of the activists, after the first Earth Day shouting and tumult had subsided, joined the old conservationists (whose numbers gave them political clout) or went to work for them (because they offered paying jobs). As time passed, the activists raised the environmental consciousness of the conservation organizations, and modernized their management and promotional practices. In symbiotic return, the conservationists gave the activists strong operating bases.

In considering this evolutionary process, one element is seldom given the credit it probably deserves. This is (or was) James Watt, Ronald Reagan's Secretary of the Interior. Virtually all environmentalists and conservationists despised the man or, more to the point, his policies. Doing something about him brought the movement together and marvelously energized it. Probably no other individual has done so much to popularize the cause, recruit members and raise money.

And so what difference has it all made—the manifestos, legislation, impact statements, money and work? In one of the aforementioned opinion polls, people were asked about the quality of their personal environments (as distinct from those elsewhere that they had read or heard about). Half of them said they thought things were about the same or better than they had been before, and 20 percent thought they might be a bit worse. If the respondents were right, this represents no mean feat of environmental protection. Between 1970 and 1988, the population increased by 40 million; the gross national product, a rough measure of consumptive activity, expanded dramatically. Between 1968 and 1984, the number of cars in the country grew by 60 million vehicles. In short, things from which the environment needs to be protected have so increased that had the effort not been made, its quality would almost certainly have declined drastically.

By some measures, discernible progress

Here and there, we have even made progress or, more accurately, retaken some ground. In 1970, for example, 200 million tons of sulfur dioxide, carbon monoxide and soot were spewed into the air as gaseous waste. Though we now generate more of these contaminants, their flow into the atmosphere has been reduced by more than 30 percent, with the result that, by some measures, the air is clearer and less noxious. This has been accomplished mainly by adding contaminant-trapping devices to industrial plants and automobiles, or changing the composition of fuels, or both.

The quantity of raw or inadequately treated domestic sewage that is dumped into surface waters has been

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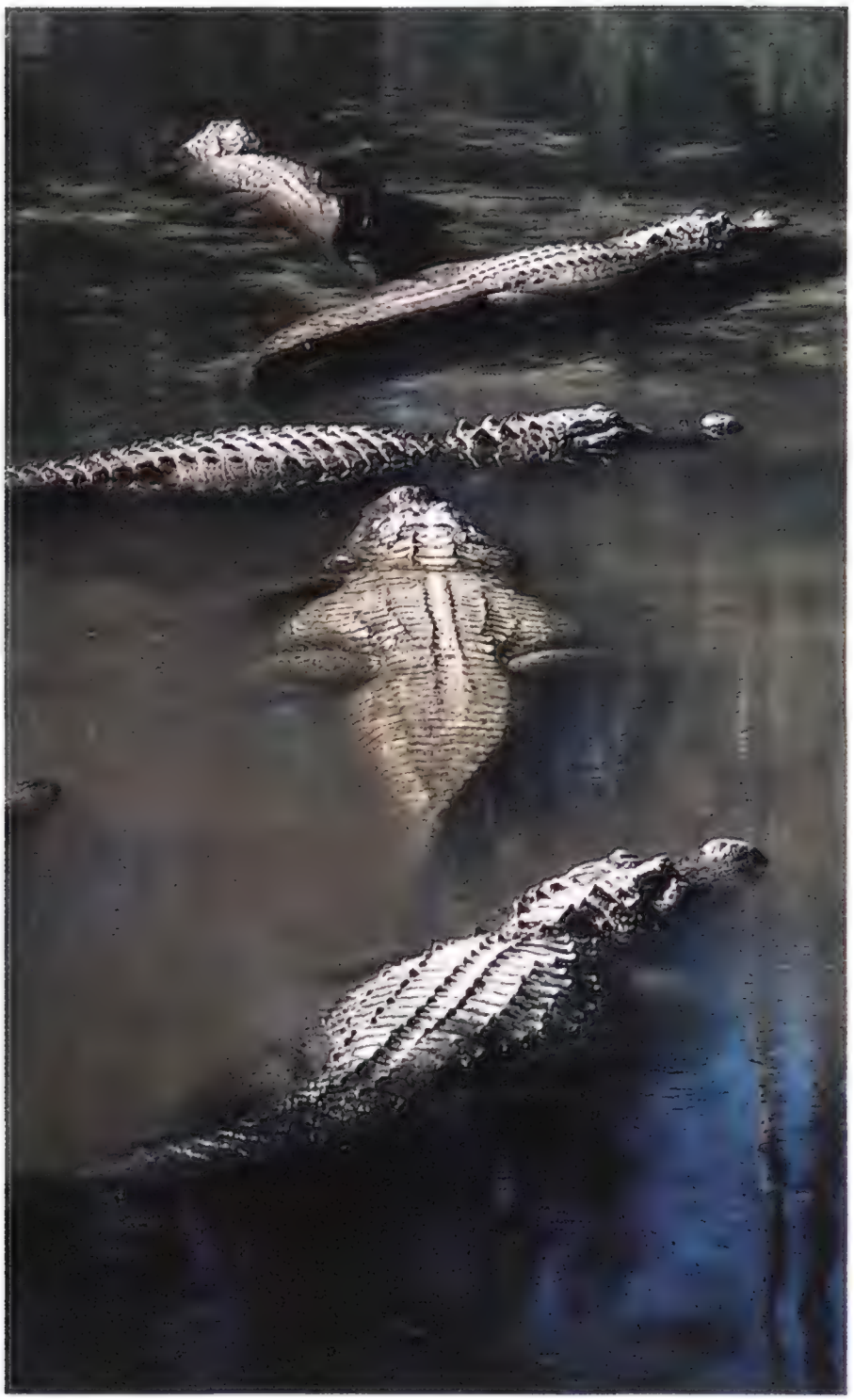

Alligators gather in a Florida swamp. Once thought to be endangered, the big predators are flourishing.

reduced substantially. Over the past ten years, the number of people served at least by secondary sewage treatment facilities has increased by 72 percent. In the early 1970s it was generally thought that Lake Erie was dying and certainly by this time would be dead—that is, would not support any aquatic flora or fauna. Presently its waters appear to be relatively wholesome and support a thriving commercial and sport fishing industry, though scientists warn that the lake continues to be threatened by toxic chemicals. Similarly a number of other lakes and rivers are now, contrary to earlier predictions, fairly lively places biologically, reasonably safe and attractive for swimming, boating and other recreational uses.

The use of a number of poisonous compounds has been severely regulated or absolutely banned. Like the names of distant battlegrounds where it once seemed the fate of the Republic might be decided, even the designations of many of the most notorious substances are becoming hazy: 1080; asbestos; DDT; Diazinon; Alar. We have been less successful in dealing with many other toxins. Government agencies have yet to regulate—or even study in detail—thousands of chemicals used at work and in the home. But we have become more sophisticated about identifying them, and we are increasingly wary about how they are produced, employed and disposed of.

A number of creatures are better off

Since 1970 eight national parks have been established, and the wilderness system has been expanded by 80 million acres. An untotaled amount of land has been set aside for natural preserves by state and local governments, private individuals and organizations. Many highway berms and medians that were formerly seeded and mowed as turf are now planted with species of the native flora. As a result of a 1985 federal law, 34 million acres of farmland particularly vulnerable to erosion have been withdrawn from production and placed in a ten-year "conservation reserve."

It has often been observed that the condition of wildlife is a good measure of general environmental quality. That the status of many creatures was poor and seemed to be worsening rapidly was an argument used with good effect in the 1970s by activists seeking new land and water regulations. Subsequently (and again because the protectionists achieved some successes) the fortunes of a number of species have improved. Among others, alligators, antelope, badgers, bald eagles, bighorn sheep, pelicans, peregrine falcons and turkeys have multiplied or at least are in stronger survival positions than they were. In almost every instance, species have recovered because people have been taught or required to protect their habitats and to stop

poisoning, preying on or otherwise molesting them.

Some species—beavers, Canada geese, crows, deer, gray squirrels, raccoons, red-tailed hawks, several sparrows and woodchucks, among others—have proved particularly adaptable in the face of human encroachment. In their cases we have not simply protected habitats but have inadvertently created new ecological niches, which they have exploited with alacrity.

Those who are most involved in its affairs tend to be the least impressed with the accomplishments of the environmental movement. Activists point out, for instance, that while we may have cut down a bit on the sulfur dioxide in the air, we are discharging chlorofluorocarbons (chemicals used in such products as refrigerants and aerosol propellants), and generating carbon dioxide as we burn fossil fuels, at a prodigious rate. Unless we reverse this trend, these compounds will probably, within the next 50 years, alter the climate and cause problems that will make all previous ones seem trivial.

Pessimism is a hallmark of the environmental movement. The movement has grown and prospered by being ever ready to point out new crises just around the corner. Consequently, environmentalists are sometimes accused of being merchants of gloom and doom who push the prospect of imminent catastrophes to recruit members, raise money and increase their political clout. Since they deal with the future, most of these indictments remain to be proved. However, in the immediate past and present, environmentalists have been extraordinarily persuasive.

The majority of Americans who look favorably on the environmental movement do not live in circumstances where endangered species, soil erosion, acid rain, the timbering of rain forests, desertification, and the quality of the air, water and land are immediate personal problems. The catastrophic consequences of a hole in the ozone layer, global warming trends and environmental diseases must largely be accepted on faith. As the opinion surveys make clear, they have been.

Jay Hair, of the National Wildlife Federation, thinks the charges that, for reasons of self-interest, environmentalists try to frighten people with predictions of coming disaster are false and cynical. Their role has been more like that of a passer-by who, seeing smoke curl out of a window, warns the occupants that their house may be on fire. Nevertheless, Hair feels that while this approach continues to be necessary, the time may have come to reinforce it with more positive ones. "We are facing enormous problems," he says, ticking off the usual ones. "But I am optimistic that, if we make a global effort, we can create a sustainable environment. Essentially the problems have been created by how we live, and the solutions require that we change how we live. I think we can, while in the long term raising rather than lowering our standards of living. However, I don't think this can be mandated from above by government regulations and treaties. It has to come about because the people themselves *want* to make changes."

Many other environmentalists agree. Their notions about creating a sustainable global environment by greatly altering the global lifestyle may strike some as being wildly impractical, even ludicrous. But so did many of the proposals that were made in 1970.

Since World War II there have been three great national reform movements—those having to do with racial, sexual and environmental relations. For some of the reasons given above, a good case can be made for claiming that the latter has had the greatest impact, psychic and material, on society. Whether environmentalists can keep up the pace remains to be seen. But because of their impressive record, the possibility that they will cannot be lightly dismissed.

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By William H. MacLeish

Where do we go from here?

We'll never regain Eden but we may atone for our errors if we find new methods of doing things in the future

These are bad days for divination. We are entering the last decade of the last century of a millennium—a passage that historically has been attended by visions of apocalypse. Beyond that, population grows inexorably. Pollution grows inexorably. The power of technology grows, too. But in the game of challenge and response, we can never be sure whether nature or human ingenuity will find ways to make the things we rightly fear go away—as the specter of nuclear winter, which terrified us not so long ago, now seems to have abated somewhat.

It goes without saying that what scares Americans most about the future is environmental, especially the possibility of a rapid climatic change followed by an almost unimaginable loss of myriad living things, perhaps even including us. At the very least there is an unsettling sense in some quarters that we may be rapidly heading toward the end of living as we've expansively known it, and the beginning of an elemental struggle just to survive.

Is that what we face? The question is much like the one Scrooge asked the Ghost of Christmas Yet to Come. There is, of course, no answer. Futurism has always been a risky business. But as the great environmentalist René Dubos observed, and Scrooge himself discovered, trend is not destiny. Both nature and humans have demonstrated, along with an extraordinary capacity for destruction, an extraordinary gift for renewal and change. And both tend to avoid the straight line. The more curious among us are always turning off the main road and scouting alternatives. If what these pioneers find looks promising, others eventually will be on their heels.

The people on the following pages are scouts of that sort. The alternatives they espouse may or may not be widely accepted in the '90s. But the range of their work—from saving energy to making more of it, from growing new crops to cleaning up the Super Bowl of Smog—and the efforts of hundreds of others around the country seem to demonstrate an abundance of what separates trend from destiny: choice.

A dedicated wolf man—with cash for cattle owners

The rancher hollers as he crosses the porch, throws his hat across the kitchen, rips the telephone receiver off the hook. The memory of the loss is still as fresh as the tracks in the bloody snow under the cottonwood: the calf dead, half eaten. Wolf, goddamnit, no question. Probably from the pack brought in to nearby Yellowstone National Park a while back. Now there are calls to make, to warn neighbors, notify authorities. And one more, to a program set up by an outfit the mere name of which would have set the rancher to cussing a year or two earlier—Defenders of Wildlife, a Washington-based group with more than 80,000 members.

Nothing wrong with this vignette except its tense. Yellowstone hasn't had a resident population of gray wolves since they were poisoned and shot out during the 1920s. But many wildlife experts, including Defenders official Hank Fischer, think the animals should be reintroduced. The park's ecosystem lacks a top predator to help control an exploding population of elk, and during hard winters the animals are starving to death by the thousands. But what would happen if the wolves strayed onto private ranchlands, where their mere presence is guaranteed to set off a ruckus?

Defenders think they've come up with a novel way to keep the local lid on. They're trying it out in the northern Rockies by paying ranchers for losses caused by wolves that have lately migrated in from Canada. That

doesn't make stockmen any less peeved, but it does disincline them to go out and shoot wolves—or hire lawyers.

There is nothing really new about this kind of mitigation, of course. In both the United States and Canada, ranchers have been compensated for their losses for years. What is new is that the compensator is not a government agency but a member of the heretofore despised opposition—a conservation organization. And this kind of tit-for-tat approach has far more consequence than the fate of a few wolves. It is part of a much larger trend toward private accommodation, sometimes on a startlingly large scale.

A private utility company in Connecticut, for instance, is planting 52 million trees in the forests of Guatemala to compensate for increases in global pollution due to the utility's stepped-up production of fossil fuel electricity near New London. The Nature Conservancy is brokering debt-for-nature swaps, valued at $9.2 million, between private companies such as the American Express Bank and various Third World countries; they will benefit conservation in the Amazon, the Ecuadorean Andes, the Galápagos Islands and Costa Rica's rain forests. During the past 20 years, environmental confrontations with private citizens and corporations were likely to end up in court. In the next 20 years, thanks to arrangements like the one being pioneered by Defenders of Wildlife, they're more likely to end up in mutually-agreed-upon compromises.

When it comes to wolves—to say nothing of coyotes, bobcats, prairie dogs and rattlesnakes—few men have had more down-to-earth experience at such accommodations than Hank Fischer. An Ohio-born professional conservationist with a graduate degree in environmental studies from the University of Montana, he runs the Defenders' northern Rockies regional office in Missoula. "Friends always kid me about the kind of animals I defend," he says, "but I'm trying to get people to accept that wildlife is good for its own sake."

Fischer has been lobbying for ten years to restore gray wolves to Yellowstone. But he gives a lot of credit for the current livestock-compensation program, which may one day make such a restoration possible, to William Penn Mott, director of the National Park Service under President Ronald Reagan. Mott saw no way of softening the opposition from sheep ranchers and cattlemen without some such concrete symbol of the hand extended. So, in the summer of 1987, when wolves moving down into Montana from Alberta killed ten sheep and five steers, Fischer raised the requisite $3,000 in damages within 48 hours. And again, last fall, after another incident, Defenders paid out $1,700.

Fischer and his colleagues at Defenders figure that Americans who want to see wolves back in the ecological order of things are willing to pay the freight.

Hank Fischer, a Defenders of Wildlife official in Montana, is trying to reconcile ranchers to wolves.

And they're right. Supporters have already contributed $60,000 toward a projected Defenders fund of $100,000, which is supposed to be enough to keep the northern Rockies compensation program afloat.

In Minnesota, where 1,200 wolves now inhabit the northern forests, state-funded livestock compensations usually don't exceed $25,000 a year. Such a program in Yellowstone, which has far less land and fewer wolves, would likely cost much less than that. The Defenders approach is also simpler than a government operation, Fischer says. Business is conducted privately, citizen to citizen—and even when evidence isn't entirely convincing, conservationists tend to agree to partial payment.

Ranchers are still dubious. So are some environmentalists, who attack Fischer and his program as "Defenders of Livestock." But there has also been a satisfying amount of favorable comment, not a little from proponents of what is called "free-market en-

William H. MacLeish is writing a book called The Day Before America*; it is about the environment of the New World just before explorers landed from the Old.*

One way is to have private groups recompense owners of sheep and cattle with cash for any stock killed.

vironmentalism," who want to see the private sector more active in the nature of the '90s. There is plenty of speculation about how this practical, eye-for-an-eye sort of bargaining could work elsewhere. Fishermen, for example, might buy water rights to insure adequate levels in their favorite trout streams.

Wolves in Yellowstone? Stockmen compensated by nature lovers for the cattle that they kill? The arrangement involves belated recognition of a practical truth: most men and all predators kill to live, but it is well past the time when the outcome can be left to purely Darwinian terms.

Amory Lovins: preaching the power of "negawatts"

The building isn't like any of the other frame or log homes along Snowmass Creek in western Colorado. Its curving walls are composed of 16-inch-thick sandwiches of stone and insulating foam, fitted with windows that are twice as effective as triple glazing but cost less. Inside, a dozen or so people work in sunlight from the windows or, on dark days, in the glow of compact fluorescent bulbs that last 13 times longer than incandescents and use a quarter as much electricity. They take their coffee breaks near a small forest of plants, including a banana tree, flourishing under a great slant of glass. They use bathrooms equipped with water-saving shower heads and newfangled Swedish toilets rigged to flush on less than a gallon of water (conventional toilets use five gallons). Though a wood stove is used during long, cloudy spells, there is no furnace. The sun—in addition to computers, lights, people and two dogs—usually generates enough warmth to keep things toasty even in 40-below snaps of the mountain winter. All in all, the place saves $7,000 a year over a similar-size conventional building.

This is the home of Amory and Hunter Lovins, and the headquarters of their brainchild, the nonprofit Rocky Mountain Institute, known to energy experts and ecologists worldwide as RMI. Hunter, a lawyer, heads up the 30-member staff. Amory, a bespectacled Harvard- and Oxford-trained physicist, and a world-class efficiency expert, oversees the research programs, many of which he originated. A workaholic with a mind like an inspired computer, he spends as much as 120 hours a week reading, analyzing, writing articles and calculating cost efficiencies, as well as caroming around the world. On any given day he might be found almost anywhere on the face of the globe, lecturing to utility executives and energy ministers about how they can make money and do the environment some good by using ingenious devices to save energy.

With him on his jaunts goes a special oversize briefcase loaded with an assortment of state-of-the-art technology—the above-mentioned fluorescent bulb as well as intricate gearing devices and motor-controlling microchips that goose up the drivetrain efficiency of the electric motors in assembly lines or refrigerators. (Surprisingly, conventional home refrigerators now account for 7 percent of all U.S. electrical consumption; Lovins uses—and pushes—a model that is as much as 12 times as efficient, mostly due to better insulation.) Characteristically he will whip out a pair of light bulbs, demonstrate that they each produce the same amount of light, then note that the first is a 75-watter, the second only an 18. By using the second you can save 57 watts. Those unused watts—Lovins calls them "negawatts"—represent a combination of more profit *and* less pollution. New plants now cost so much that utility companies can make a higher percentage of profit by encouraging customers to use less electricity.

His 18-watt bulb costs $20 but lasts about 10,000 hours, compared with a 70-cent cost and 750-hour work life for a conventional bulb. During its lifetime it thus replaces a dozen conventional bulbs, and saves much of the $20-$30 in fuel needed to generate their

Rocky Mountain Institute's Amory and Hunter Lovins are compelling apostles of making profit while doing the environment some good, by using ingenious devices like 18-watt bulb they hold. It gives as much light as a conventional 75-watter, uses a fourth of the energy, and can burn for 10,000 hours.

electricity and as much as $300 in generating capacity. If these bulbs (they're available now at energy-conservation stores and from several mail-order companies) and other available lighting efficiencies were in general use, Lovins goes on, we'd get better illumination at 10 percent of the present cost, with a corresponding annual cut of $30 billion in the cost of fuel needed to provide the United States with electricity. If the world *really* got serious about improving energy productivity, he insists, thereby reducing the "greenhouse" gases produced by the combustion of fossil fuels, it could save a cool trillion dollars annually, roughly what the community of nations now pays to defend itself from itself each year.

This is dramatic stuff, though hardly more so than the transformation that Amory Lovins' reputation has undergone since the '70s, when he wrote his best-known book, *Soft Energy Paths*, and the energy Establishment identified him as a sort of enfant terrible, a brash, eco-freak scourge. Today they listen—RMI's commercial clients fork over $6,000-a-day consulting fees.

If the Establishment has changed, Amory Lovins hasn't—at least not much. "I've never been interested in just doing with less," he says; "I'm interested in doing *more* with less. We don't have to become vegetarians and ride bicycles to save the Earth." He admits he has become better at listening, however, and much better at translating his message into terms that fit in with changing business beliefs. "We're telling managers how to make so much profit out of negawatts," he says, "that they can pay off the huge costs of plants they wish they'd never built." Clients from 30 countries now subscribe to RMI's profitable *Competitek*, a regularly updated report on new cooling and heating devices, lights, motors, and other modest efficiency products and systems that keep showing up in the industrialized world every few months.

Lovins' basic approach is something he calls "end-use/least-cost," a vernacular translation of which is, "You don't need a chain saw to cut butter." A much-publicized recent example: after metropolitan Denver (pop. 1.4 million) was told that to meet its water needs it would have to build the controversial $1-billion, 359-billion-gallon Two Forks Dam, an RMI study showed how those needs could be met with no dam, and at an eighth of the cost. The RMI alternative: a shrewd combination of efficiencies, including thrifty shower fixtures and lawn-watering equipment. In part as a result of the study, the Environmental Protection Agency is likely to scuttle the dam project.

To Lovins' considerable delight, a number of utility companies have also begun marketing negawatts, encouraging customers to save money by saving energy, and then sharing the profit from not having to produce an ever-increasing amount of electricity. Regulations have been eased in eight states, enabling a utility that feels a supply strain to run a kind of low-bid auction to buy power from other, perhaps more efficient, companies. By the turn of the century, Lovins hopes, his approach will have supplanted costly new plant construction as the normal way of doing business for utilities.

Amory Lovins epitomizes some old Yankee princi-

ples not always popular in these days of apocalyptic environmental thinking. At a recent conference they were summed up by climatologist Stephen Schneider, when he was asked how we are going to solve our horrible global problems. "You do a nickel's worth of work here and a dime's worth there," he said, "and pretty soon you've got a half-dollar—and maybe your problem's half solved."

Wes Jackson: visions of a gama grass prairie

By training, Wes Jackson of Salina, Kansas, is a skilled, practical geneticist; by trade, he's a professional visionary. From outside appearances, he is all impatience. Jackson doesn't walk, he charges around the Land Institute, otherwise known as "The Land," a chunk of tawny grassland just outside town that's part of a research and educational center he and his wife, Dana, founded more than a decade ago. But inside, Jackson is a veritable Job. He has devoted his life to the exquisitely protracted business of breeding plant combinations that will flower, if they flower at all, long after he has been gathered to his fathers. If Jackson's current experiments succeed, many of the fruitful, cultivated fields that will nourish us in the next century and beyond will look to the lay eye like ragged pastureland gone wild.

All plant breeders need a long string of growing seasons to strengthen this trait or repress that one. In conventional agriculture, they mostly work with the germ plasm of annual grasses, such as corn and wheat, breeding for increased yields and for such qualities as resistance to pests and to disease. Each small success has tended to require an increasingly sophisticated support system of biocides and synthetic feeding, and critics like Jackson believe that such procedures are environmentally unacceptable. In fact, they say, at least on the erodible soils and sloping ground typical of three-quarters of our farmland, the whole system of plowing, planting and harvesting has become a disaster, responsible for the loss of about one-third of this country's topsoil.

Instead, what plant scientists and the work teams of young interns at The Land are trying to do is to follow Jackson's first commandment: let nature be the standard. Their goal is to lay the groundwork for something that he calls "prairielike grainfields." As a first step, these should be established on land now too rough or too delicate for conventional row-crop farming, which they will eventually replace. This acreage would grow not corn and wheat, which must be seeded every year, but a mix of hardy perennials, some of them offspring of the wild grasses that make up what is left of the Great Prairie. The ultimate objective: a polyculture that would produce food for man and beast but that needs little care and no high inputs of fertilizers, herbicides and pesticides. Just as important in Jackson's vision, future cultivated fields, like a true prairie, would build and hold the topsoil rather than losing it to wind and runoff as row-crop plots do now.

He has been working on The Land for 12 years. It now consists of 277 acres laid out in patches ranging

An ever-patient geneticist, Wes Jackson examines a stalk of Eastern gama grass, one perennial plant with which he hopes to create "prairielike grainfields," someday capable of feeding the world without all the plowing, planting, watering and fertilizing that now often lay waste to topsoil.

from native prairie to plant-breeding plots. They have not begun to produce the kind of yield Jackson hopes for. To make his prairie work, he knows he will have to breed plants that will not "shatter," that is, cast their seeds at the slightest touch as wild plants now do. He must also breed them so they will send more energy into making edible seeds. He talks of finding a sunflower or some other plant that will protect the seedlings around it from pests, and is mixing in legumes, such as Illinois bundleflower, to fix nitrogen in the soil to nourish his crop.

He is also experimenting with a giant wild rye imported from the USSR and other Eurasian lands. But the plant he seems to be encouraging most, the way a trainer works with a long-distance runner for an upcoming race, is Eastern gama grass, a distant relative of corn but with three times corn's proteins and a slightly similar taste. Gama now offers only a gangly, birdfoot head; if it is to provide cereal, Jackson and his colleagues will have to breed it for a cob. Gama grass doesn't have enough stalk strength yet, either. With $5 million, Jackson says, smiling, he could look into building such a cob. "That and 25 or 30 years."

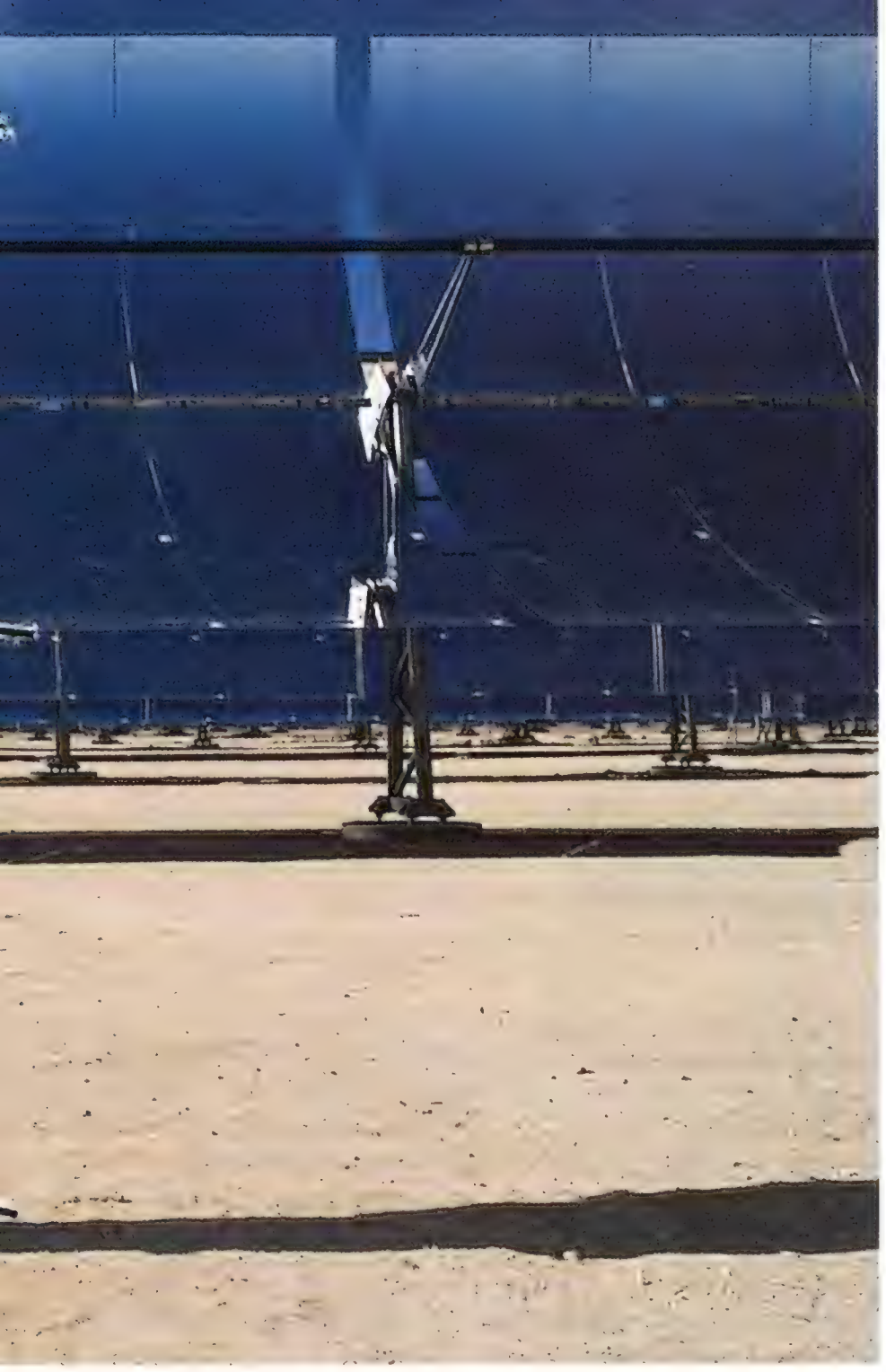
If Jackson's assumptions prove correct, his future prairie might eventually flourish on some 350 million erodible acres, most of the currently cultivated land in the United States. Farming it would be very different from the way we do it today. Manure from foraging livestock might be enough by way of fertilizer. Much of the time, farmers would roam like naturalists, checking ecological balances of particular landscapes and such growth and timing factors as when the birds return in spring. They would have to plow and seed only when their prairie seemed senescent—every three years, maybe, but more likely every five or ten.

As Jackson sees it, the sheer diversity of the planting would discourage insects or fungi. There would be one

Backed by miles of mirrors, Jim Bazor manages Luz International, world's foremost solar energy producer.

or two harvests a year, by special combines equipped not for cutting but with a variety of seed-gleaning devices. Pressed for production details, he asserts that the self-supporting prairie could yield close to the 1,800 pounds per acre of grain nourishment now being produced by the average cultivated, fertilized acre of Kansas wheat.

Twice in his adult life, Jackson has been told he had cancer, and both times the diagnosis proved wrong. Time spent with that kind of fear appears to have given him an appreciation of risk taking. Jackson has few advocates in agribusiness (and more than a few enemies), but he now has financial backing from supporters all over the world, and he feels that he can find what he needs to demonstrate the validity of at least some of his views by the end of this decade. In a geneticist's terms, he points out, that is only the day after tomorrow.



New technology, called "solar thermal," may make the sun a source of economically viable energy at last.

Luz International: having another go at the sun

The glittering troughs look like neat rows of polished snowplow blades stretching away across California's Mojave desert. Their purpose is to run the world's largest solar plant which, together with seven solar sisters also operated by a company called Luz International, creates more than 90 percent of the solar power generated not just in the United States but in the entire world. According to chief operating officer James Bazor, the total capacity is 274 megawatts—roughly the residential power used by a city the size of Miami or Cincinnati. That puts Luz close to the realization of a dream most of us thought dead, the economical use of vast amounts of electricity, derived not from fossil fuel but from that life-giving, unpolluting and probably eternally renewable source, the sun.

The solar dream seemed most promising after the oil crunch of the mid-1970s, when a flurry of private and federally financed R&D projects across the country led to the creation of a new technology based primarily on the photovoltaic cell, a sandwich of semiconductor plates that directly produces energy when exposed to the sun. The combination of sunlight and polarity between the plates forces electrons to the middle of the cell, where they are collected as electrical current. But photovoltaics still have not proved cost-effective in generating power.

That's why Luz does it with mirrors, in a startling approach called "solar thermal." The mirrors are arranged in long rows, each with a pipeline running down its center. Computer-controlled to track the sun, the mirrors focus its reflected rays on the pipes, and a heat-retaining oil inside quickly hits 735 degrees F, turning water in a heat-exchange system to steam, which drives traditional turbines.

Photovoltaic cells are still being improved, but right now solar-thermal power is almost three times cheaper. For the foreseeable future, the solar-thermal method developed by Israeli-American scientist and entrepreneur Arnold Goldman appears to have made all the difference in the volume and cost efficiency of using the sun. Electricity produced with fossil or nuclear fuel sells at about 5 cents to 7 cents per kilowatt-hour and accounts for 33 percent of the carbon dioxide the United States currently spews into the atmosphere. Luz promises nonpolluting solar-thermal power at 8 cents, or better, per kilowatt-hour.

There are still limitations to this approach, involving the daily proportions of darkness and daylight, and the conditions of climate. During long stretches of cloudy weather, Luz sometimes has to resort to a gas-burning backup system. The Mojave plants are not designed as wheelhorses of power generation; conventional utilities still fill that role, supplying their customers with a base load of electricity. What Luz does is supply those utilities with peaking power—energy needed when, as often happens, Los Angeles, 135 miles away, is sizzling and air conditioners are bleeding the system. The Luz plants seem ideally situated for this purpose: the Los Angeles demand curve coincides neatly with the sun's own arc over the Mojave. This means Luz can turn a profit by running the plants for about 13 hours a day; but it also means that any company Luz supplies doesn't have to build expensive new plants that burn dirty fuel to meet a demand that is only intermittent.

It took five years and $1 billion to complete what is, in fact, the first commercially viable system of solar plants in the world. James Bazor, a Mississippi farm boy turned engineer and construction expert, has worked for years in both the fossil- and nuclear-energy fields, and he helped build the Luz facility be-

Smogless sky used as part of office decor symbolizes future that James Lents is now striving to create for 12 million citizens of the Los Angeles basin. Lents' method: a full-court press, including fines on all manner of pollution, from cars to buses, from spray paints to deodorants to charcoal-lighter fluid.

fore accepting the company's offer to run it. So far, the company's enthusiastic investors—mostly large utilities but also the insurance giant Prudential—have put up almost a billion dollars.

With that kind of bankroll—and all-important tax credits established to encourage alternate energy sources—Luz can well afford to prospect for plant sites elsewhere in the Southwest. It is also part of a consortium negotiating to build solar-thermals in Brazil and Mexico. Wherever large markets exist under the sun, it appears, Luz will be there looking.

James Lents: As L.A. goes, so goes the world?

It is well known that the country's foulest airshed lies festering over the Los Angeles basin. But things would be even worse in the Super Bowl of Smog were it not for an atypically hard-nosed regional agency with a typically bureaucratic title, the South Coast Air Quality Management District (AQMD). It's headed up by James Lents, a tall Tennessean who is potentially one of the most powerful people in Southern California. Since its inception in 1977, with a little help from state regulators, the AQMD has cracked down so hard on auto and industrial fuels that one of the nastiest air pollutants around, sulfur dioxide, has been held to acceptable levels. Ozone has been dramatically reduced as well. There are many other pollutants, however, and notwithstanding the AQMD's efforts, Los Angeles missed a 1987 deadline for full compliance with federal and state air standards. Environmentalists looked to Uncle Sam for a solution, but Lents and company just kept working. The result is a controversial full-court press against pollutants that may yet prove a workable blueprint for great industrial cities everywhere.

Still, Lents and his staff of more than 900, including lawyers, scientists, engineers and planners, are confronted by the fact that greater Los Angeles has been experiencing a period of intense growth. What is so remarkable about their plan? Consider. The AQMD has issued, or is working on, regulations for further limiting not only harmful emissions from the region's eight million vehicles, but also air pollution from printer's ink, spray deodorants, dry cleaners, house paints, swimming pool heaters and even charcoal-lighter fluid. It charges handsomely for required annual inspections as well as for permits to operate a steadily increasing number of businesses. And it can slap fines of up to $25,000 per day per violation on those who don't comply.

The power to do these things ultimately has to be approved by voters and is reviewed by a 12-person board, 9 members of which are elected from local jurisdictions. In spite of these constraints, much of the clout is wielded by Lents, who says he "backed into" environmental work after earning a doctorate in physics from the University of Tennessee and serving a stint in aerospace work. For seven years he directed Colorado's air pollution program. In Los Angeles he presides over the largest budget of its kind in the country—$80 million annually—most of it raised directly from companies through those permit fees and fines.

The overall plan Lents is trying to implement is set forth in a stack of documents more than three feet

high. Its aim is to attain full compliance with federal air-quality standards by the year 2007 through an almost unimaginable network of interlocking controls and cleanup measures. Basically, though, Lents is pursuing a simple two-part strategy. The first part is continued enforcement of pollution controls already known to be effective. This includes much tougher restrictions on car emissions, the psychologically important building of new subway and commuter railroads, and the promotion of car pooling. The second part, he admits, will have to come from new technology, and from the ability to transform futuristic air-cleaning methods and devices into practical, money-making market items—and also from some increase in public worry and self-discipline.

Right now, the AQMD has to concentrate on the tailpipe emissions that supply about two-thirds of L.A.'s pollution. Larger employers are required to offer a range of ride-sharing incentives, such as monthly bonuses, though so far less than 20 percent of workers are cooperating. New automobiles, already equipped with advanced emission control devices, will soon be required to run on cleaner fuels like natural gas or methanol, which powers 30 buses the city is now testing.

Much of the advanced design will have to come from Japan and Europe because American companies have shied away from investments that may not pay off for a decade or more. But the AQMD is in touch with several U.S. firms like Chrysler, which is developing a battery-powered van with a 100-mile range and is working with the Palo Alto-based Electric Power Research Institute on a seven-passenger, battery-operated vehicle that will do 65 to 70 miles per hour on the open road.

Coatings and solvents in the industrial sector are another important target for Lents' people, who recently approved the most restrictive limits on paints and other wall coverings in U.S. history. Finishes for furniture, chrome for bumpers, and many similar compounds are extraordinarily toxic, and the search is on for acceptable alternatives. Even the wonderful-smelling emissions from the stacks of large bakeries are coming under scrutiny.

Though the plan will eventually affect just about everybody in or near the city, Lents thinks that over the next decade most Los Angelenos will be able to adjust, especially if the dangers are explained and the changes are implemented gradually.

Neither he nor other district planners seem abashed by the plan's predicted cost of around $3 billion a year. Why? For one thing, the cleanup will save an estimated $9.4 billion annually in health costs. For another, it is not unthinkable that if the Los Angeles area can't meet all federal standards by 2007, it could lose tens of billions in state and federal funding for transportation and sewage purposes, something opponents sometimes neglect to factor into the equation. Right now financial sanctions from the EPA are discretionary. But by 2007, if the past is any precedent, attitudes could be very different. Economic challenge and response can have remarkable results. From the mid-'70s to the mid-'80s, when the country was trying to become independent of Middle Eastern oil producers and save on rising fuel costs, the gross national product grew by 35 percent, while American energy use remained constant, thanks to conservation efforts.

Already Lents' all-out attack on air pollution is attracting attention from Mexico, Taiwan, the Netherlands and other countries where urban eyes smart and urban lungs burn. It is sure to attract even more interest when the poisoned cities of Eastern Europe and the Soviet Union get around to cleaning up their act. "What we're doing here"—James Lents shows his conviction with a little extra Tennessee twang—"is going to have to be done worldwide."

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By Richard Conniff

The transformation of a river—from 'sewer' to suburbs in 20 years

When it was dirty, people shunned it.
Now that it's clean, they flock to it. Question:
Was the Connecticut better off before?

At dawn, reflected boats and clouds shimmer on the Connecticut River's glossy surface. In recent years, boating and development have increased at rates that astound those who recall more-tranquil times.

One morning last fall, I took a stroll out a grassy spit of land called Griswold Point, where the Connecticut River enters Long Island Sound after wandering more than 400 miles through New England from its source in northern New Hampshire. At that time of year, with the summer boaters gone, it was an extraordinarily placid scene—a major waterway in the heart of the Eastern Seaboard ending not, as you would expect, in a great city but in marshes and forested hills. I was walking with Evan Griswold, whose family has lived around the mouth of the river in Old Lyme, Connecticut, since a forebear arrived in 1640 to cut stone for a fort at the first English settlement. Griswold was taking the pessimistic long view of the river's future, which had to do with such problems as global warming, suburban sprawl and the failure of government to protect the environment. Somehow the thought did not jibe just then: the clear water flowing past our feet struck me as impressive evidence of a government success in such matters. I was thinking about an environmental cleanup that, on one level and at least for the short term, was a reproof to pessimism. I was thinking, in other words, about the Connecticut's remarkable comeback.

Griswold himself could remember when raw sewage routinely drifted past this point, and when coming in contact with the water was associated with the dangers of typhoid and diphtheria. He sometimes goes crabbing on the river now with his children, but he could recall when blue crabs and fiddler crabs were unknown. The historic turnaround that took place here began in October 1972, when the Congress overrode a Presidential veto to make into law the visionary legislation known as the Clean Water Act.

Headlines at the time did not herald a new epoch for America's rivers, but in the Connecticut watershed

Photographs by Robert Benson

Students from Windsor, Vermont, sample the waters to test the dissolved oxygen content and turbidity.

alone, the Clean Water Act and its subsequent extensions produced 125 new or upgraded wastewater treatment plants at a cost of nearly $900 million. A single law took "the nation's best-landscaped sewer," as the Connecticut was then known, and made it safe for fishing and swimming. The restoration produced some serious complications, too, but this essential achievement stands out: no Griswold since Evan's great-great-grandfather's time, back in the 1830s, has seen the Connecticut River so clean. Ospreys, bald eagles, Atlantic salmon—and, in vastly greater numbers, people—have begun to return.

The transformation is not complete. Beginning some 30 miles above the Sound, along an urbanized section that extends from Middletown and Hartford in Connecticut on up through Springfield, Massachusetts, scores of combined storm and sewer systems still overflow after it rains, pouring millions of gallons of raw sewage into the river. When I visited an open pipe five feet in diameter in Chicopee, Massachusetts, one day, I found a steady stream of slaty-gray water coursing over concrete rubble that was bearded with toilet paper—and that was in dry weather.

But even at Chicopee the water is clean relative to what the entire river used to be. In 1963 a federal researcher reported that "clumps and rafts of sludge boil to the water surface buoyed by the gas bubbles of decomposition." In the sludge blanket on the river bottom he found a thriving population of up to a thousand sludge worms per square foot—and almost nothing else. South of the paper mills in Holyoke, Massachusetts, the river ran different colors depending on the dye lot of the day. Plastic particles littered the surface, and boaters had to hold their noses and scrape greenish-brown scum from their waterlines. Most of the river was officially classified as "suitable only for transportation of sewage and industrial wastes."

A science laboratory for students

While wastewater treatment plants and limits on industrial pollution have changed much of this, the shift away from woolen mills and machine tool factories to a service economy has helped, too. To see the difference, I went out on the river one day in Windsor, Vermont, with a ragtag army of teenagers in Batman sweatshirts, black-painted fingernails, blue jeans and untied high-top Reeboks. Groups from seven high schools were swarming over 120 miles of the Connecticut River in Vermont, New Hampshire and Massachusetts. They were equipped by their schools and by two conservation groups—the Riverwatch Network and the Connecticut River Watershed Council—with thermometers, pocket meters for measuring pollutants, turbidity meters and probes to gauge dissolved oxygen in

the water, all useful tools for assessing a river's health. From each site, they took three water samples in bottles held out at the end of extension poles. Then they adjourned to their laboratories, where they completed a series of nine pollution tests for each site.

The most notorious indicator of pollution is fecal coliform bacteria, which comes mainly from human waste. The standard for swimmable water varies from state to state; in Vermont it is 200 bacteria per 100 milliliters (about 9 bacteria per teaspoon). The Riverwatch tests on the Connecticut have generally yielded counts under 100. Probably because of recent rainfall, the results from the Windsor High School group were disappointingly high, ranging up to 298. But even this was a substantial improvement over the mid-1970s, when researchers in the same area reported rainy-weather counts of 920 to 1,400. When the Windsor students put their test results together, they ended up giving the different sites grades of from 70 to 92 out of 100—healthy, but with room for improvement.

Here, and for much of its length, the Connecticut does not look as if it was ever polluted. Outside the main urban section, the landscape conveys a sense of well-being about the river. In the lower stretches, it is often possible to imagine that the modest, glaciated hills appear now as they did to the Indians. (The most important geographic feature here is a sandbar running from Griswold Point across the river mouth; it spared the estuary from development as a port.) In its middle reaches, through Massachusetts, the valley opens out in broad, flat "intervales," a regional term for the rich bottomland beloved by dairy and tobacco farmers. Though the towns here are rapidly becoming more populous, many cling to the orderly farm-and-hamlet character of the classic New England village. Farther north, where the river separates Vermont from New Hampshire, the mountains become steeper and hem the valley in more closely. Here the riverfront cornfields are curving, elongated strips, and towns often appear first among the mountainous declivities as white church steeples, proud and severe against the flamboyant backdrop of autumn.

It is the kind of landscape people become passionate about. As they went about the great work of cleaning up the Connecticut, few environmentalists paused to think that it had remained one of the nation's best-landscaped rivers at least in part *because* it was a sewer. Its smelly reputation had protected it from development just as surely as had the unseen sandbar at Griswold Point. Almost the only person to say so in 1972 was Abe Ribicoff, then the senior U.S. senator

Connecticut freelancer Richard Conniff wrote last year about roller coasters, the aftermath of Yellowstone's fires and tropical fish collectors.

Evan Griswold and Corey huddle at riverside on a point in Connecticut that has been in his family since 1640.

Terry Blunt, who acquires frontage for the state of Massachusetts, is worried about shoreline development.

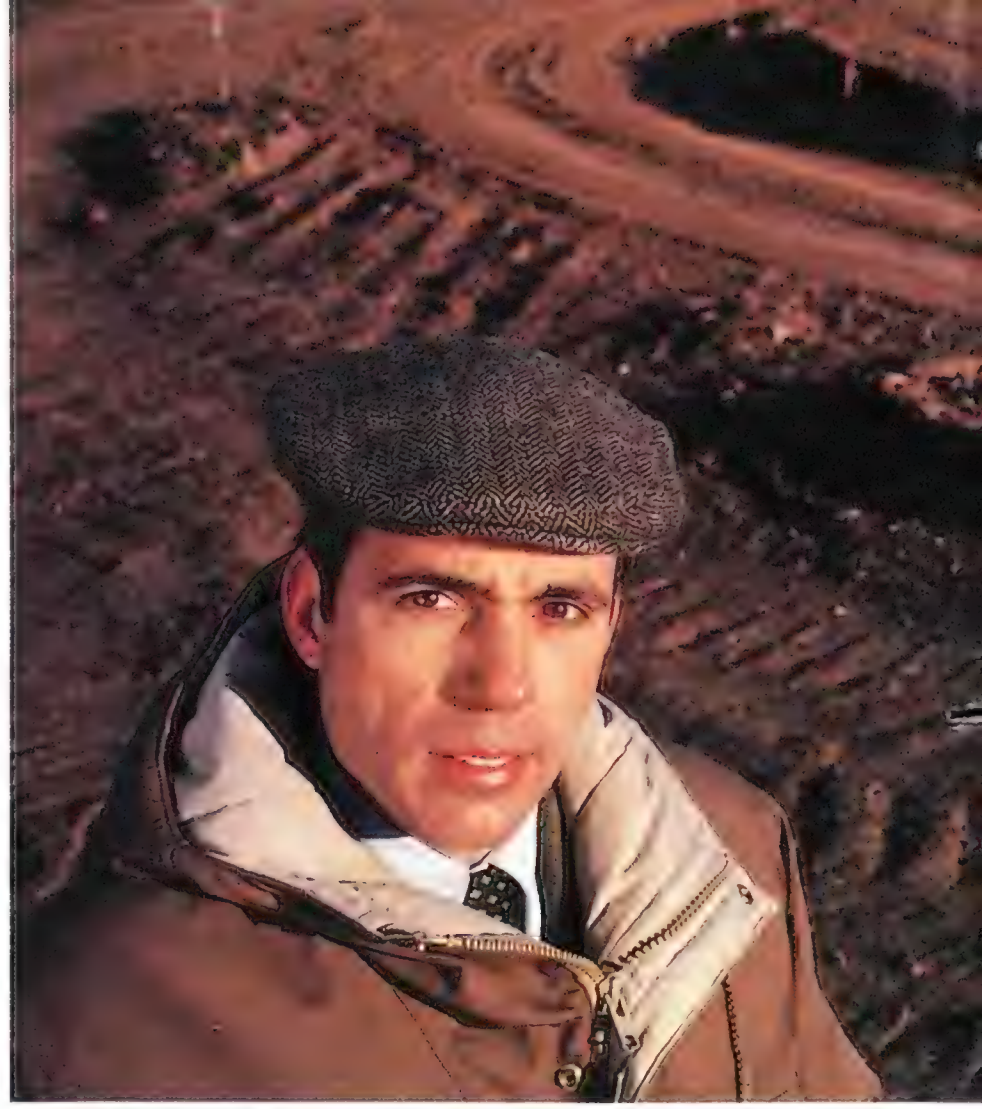
Julie Zickefoose, a wildlife artist, holds sketchbook in lap while watching birds from perch at water's edge.

from Connecticut. "The enactment of federal pollution-control laws . . . means that the untouched areas will be ripe for development," he warned. "Unless action is taken to prevent it, the riverbank from Long Island Sound to the Canadian border will be covered with manufacturing plants, shopping centers, housing tracts, and marinas."

Today Ribicoff's prediction may be coming true, and one indicator is that the river itself is now covered with boats. This was, of course, the idea—to make it clean enough for people to enjoy—and in that sense the contrast between the new Connecticut and the old makes a powerful argument for the social and economic benefits of pollution control. But in the 1980s the number of boats and their collective horsepower grew rapidly enough to alarm the boaters themselves. On weekends, the river often looks as if northbound and southbound Interstate 91 have been plunked down on the same lane, and nobody has any brakes. Groups of boats charge toward one another like squadrons of cartoon sharks, prows up, fangs bared and wakes foaming. The hillsides reverberate with the thunder of 260-horsepower muscle boats and the petulant whine of the waterborne dirt bikes known as jet skis.

Many newcomers to the river hew to the old idea that the water is beyond the law. Last summer, a Massachusetts man pitched a tent on an island in midriver and ran a cocaine emporium until the police showed up. Lawmen there also answered complaints of a riverside sniper firing at passing boats, and of two gentlemen on a boat shooting at the riverbank. Regrettably, those incidents did not occur at the same time.

The narrow confines of the river produce a kind of territorial psychology among boaters. "Look at the size of these things!" Terry Blunt exclaimed one day as we walked among the Bayliners and Stingrays crowding a large riverfront marina. Blunt, who oversees the river



Land-planner Randall Arendt inspects farmland near river; it's being bulldozed for home development.

Police ticket a powerboat for speeding. As traffic on the water mushrooms, so do problems and user conflicts.

for the Massachusetts Department of Environmental Management, is an unflappable sort in a blue windbreaker and thick, gold-rimmed eyeglasses. "You get some guy who's bought one and he begins to equate his investment with his rights on the river. He's paid a lot for his registration fee. He's paid a lot for his slip. He's paid a lot in gas tax. No one's going to tell him to slow down just to avoid swamping some hick fisherman in a 15-foot skiff with his grandfather's motor on the back."

A few days after we talked, Blunt presided over a meeting at which one benighted motorboater declared, "If you want to canoe, go to the Deerfield River where powerboats can't go." Other boaters argued for a variety of new controls, including reduced-speed zones (down from the present 45 mile-per-hour limit), stiffer penalties for boating under the influence of alcohol, creation of motor and nonmotor zones, and mandatory safety classes and licensing for canoeists and motorboaters alike. Of necessity, life on the Connecticut is being suburbanized.

What really troubles Blunt is the more-permanent suburbanization taking place on the banks of the river. Much of this might have occurred anyway, as interstate highways opened the valley and as New England's economy expanded. But Blunt, whose duties include buying land to preserve the river's character and to guarantee continued public access, sees the cleanup as the main source of the pressure. The river is an amenity now instead of a nuisance. At its mouth, a single three-acre waterfront lot sells for $1 million. At such prices, conservation generally loses out to new houses. "We've kind of outsmarted ourselves," Blunt said.

A trek to the source of the river

To get a different perspective on what he was talking about, I drove up one weekend to the source of the river, in Pittsburg, New Hampshire. It snowed the day I'd set aside to visit Fourth Connecticut Lake, but it was only a one-mile hike in from the U.S.-Canadian border station. Besides, this trip had special meaning for me. In 1982, I abandoned the BosWash corridor, that sprawling, undifferentiated East Coast anyplace, and settled in an area that seemed to have a very distinct sense of place, buying an old house from which I could see the river and watch the sun setting on the hills opposite. I'd never been to the source of any river, much less one I've come to care about deeply, so I thanked the officer at the border station for his warning about the weather and headed into the woods.

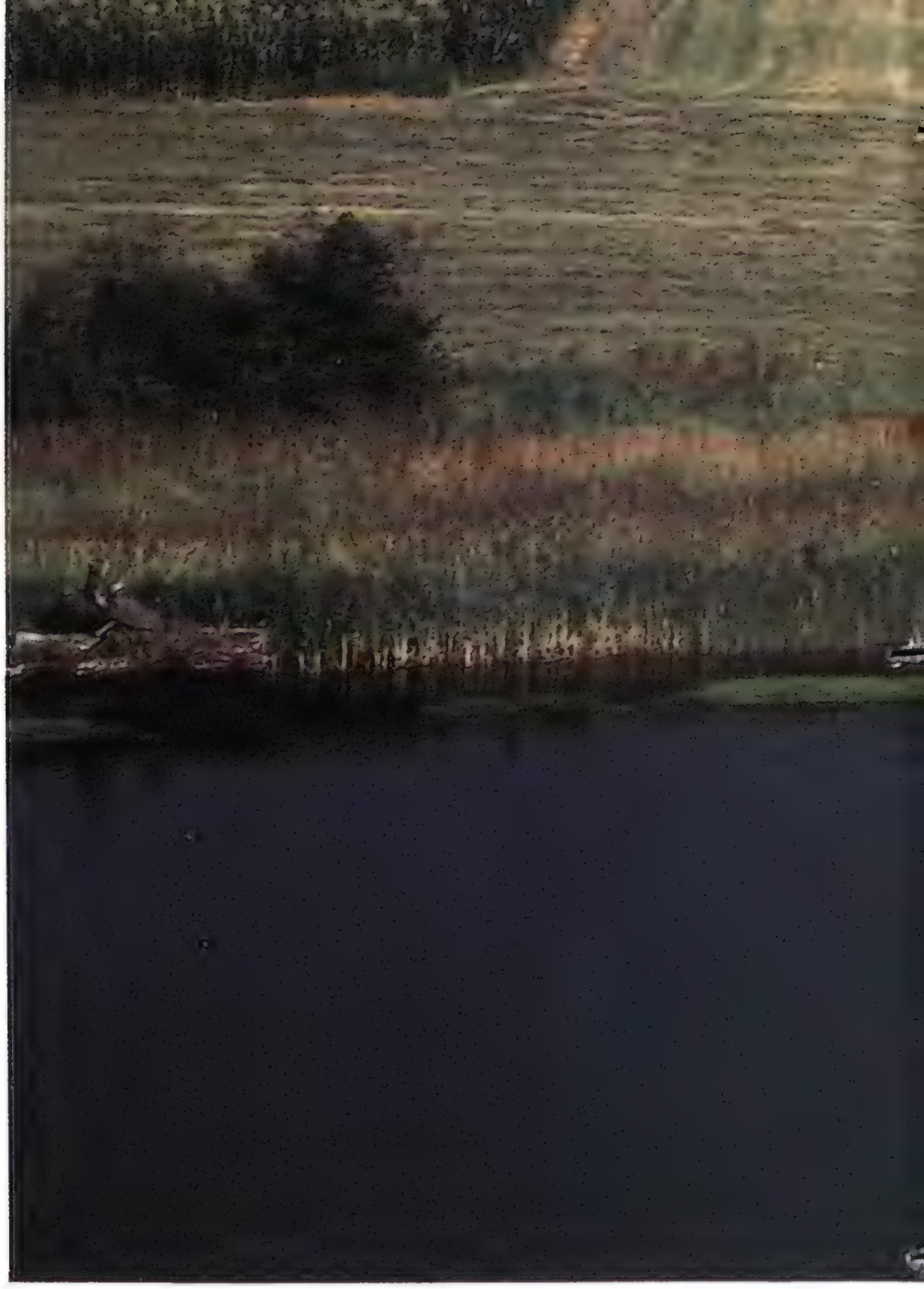
The trail turned out to be slightly better than an animal track, overlapped in places by young spruce trees that unloaded snow onto my jacket. In other places the trail disappeared altogether, and I thrashed around thinking ludicrously of explorers Burton and

Text continues on page 80

Lone sculler rows along Connecticut as light reflected from buildings in Hartford colors the morning mist.

Near its source in New Hampshire, the river snakes past a gravel pit (upper left) and cultivated floodplains.

Engaging in a time-honored pursuit, youngsters swing into a swimming hole near East Thetford, Vermont.

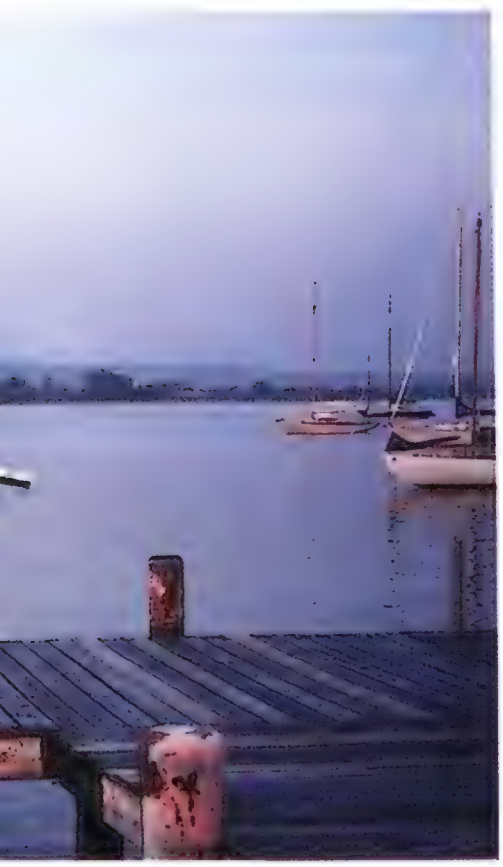


In a scene that sums up changing times, speedboat barrels past farmer harvesting hay in New Hampshire.

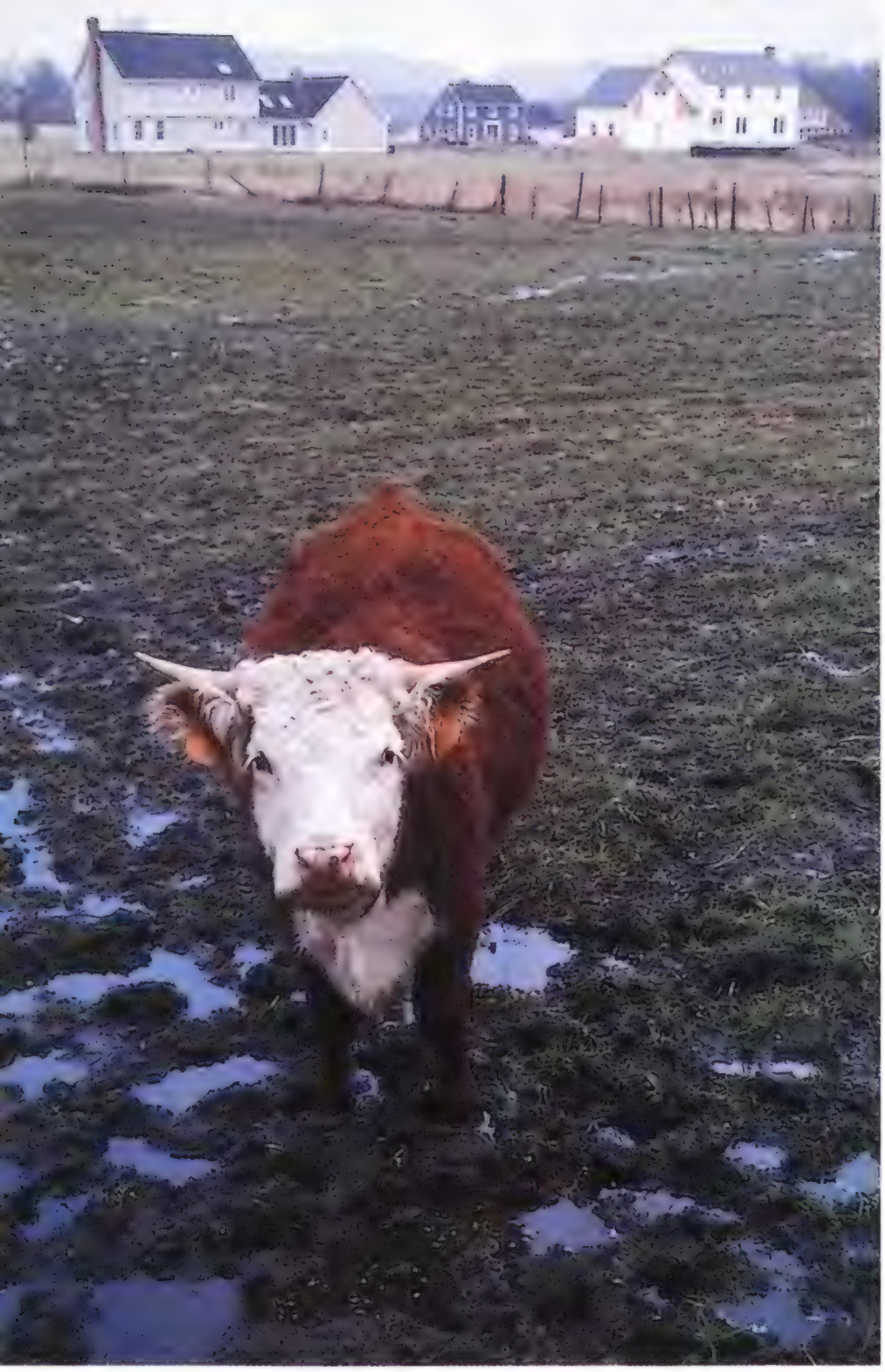
Lights glimmering, pleasure craft crowd together prior to start of July 4 fireworks on riverbank in Hartford.

A family enjoys quiet evening on the dock at Essex, Connecticut, where sailing remains a popular pastime.

Northern stretches of river valley are still mostly agricultural, but suburbanization is coming on strong.



Well upstream from Essex, in Massachusetts, boats leave their wakes on one of the river's busiest sections.



Not far from the river in Massachusetts, a solitary bull stands its ground in a pasture next to a subdivision.

Speke seeking the source of the Nile without benefit of signposts. Eventually, though, I found the lake in a high, bowl-like area encircled by a ridge of spruce trees. It was a pond, really: 120 yards across, its pewter surface rippled by the wind. For no good reason that I can think of, except to show that I'd been there, I filled a bottle with peat-colored water from the south end of the lake, where the river begins its long journey down through the heart of New England. Then I headed back.

The brief suggestion of wilderness there was reassuring, and I stopped on the hike back to look at the seemingly endless forest below. Most of that land is owned by logging companies, which conservationists have come to regard as a bulwark against development. Here at least, it seemed, the river would continue to be surrounded by trees rather than suburbs.

But it turned out that suburbanization was already well under way even here, in the remote riverhead town of Pittsburg. I toured the area one afternoon with Carl Carlson, a big former warden with a chewed-off cigar in his teeth who serves on the local planning commission. Every time we passed a choice piece of intervale he would say roughly the same thing, in a carefully neutral tone: "This used to be an old farm. The old Wheeler farm. A big farm in its time." Or: "This one hasn't been developed yet. Some problem with the probate court." Everywhere the land was marked off with pink surveyor's ribbon into five-acre lots, the size at which certain forms of regulatory review are no longer required. Such lots are popular among urban hunters and fishermen who hope someday to build "getaways." The gravel-road subdivisions carved out of every field and slope and wetland tend to be planned with about as much sensitivity as gold rush shantytowns.

A responsibility to keep it clean

Afterward I spoke with Bing Judd, head of Pittsburg's board of selectmen, who was proud to be overseeing completion of the river's northernmost wastewater treatment system, which now serves 107 homes in town. He was also pleased with the annual tax revenues being generated by the 500 or so new getaway lots that have been sold in the past three years—none of which will be hooked into the sewer system. Driving along a lumpy streamside road in a new development, Carl Carlson had seemed distinctly less sanguine. "We're the headwaters of the Connecticut River," he'd mused. "We have a responsibility to keep it clean. When they start building septic systems in there, we're going to find problems. Ain't no way you can build anything that close to the water."

Downriver, where they don't know what Pittsburg is up to, people tend to be more cautious about the placement of septic systems—and a bit more skeptical about the notion that development produces more tax dollars than it actually consumes. Even so, new houses are already crowding the river, especially in Massachusetts and Connecticut, and each piece of landscape lost is a blow to the heart for people who know the river.

Julie Zickefoose, who paints birds for a living, used to watch a great horned owl cutting up its prey on a high bank overlooking Whalebone Cove, ten miles up from the river mouth. Then a family built a big house there. Now the same family is building an even bigger house on the river itself, on another favorite birdwatching site. The new house stands at the end of a narrow, low-lying peninsula called Selden Neck, which is sometimes cut off from the mainland by floods. What some locals call "in-your-face" architecture is popular on the river, even in such dicey loca-

The eagle has landed.

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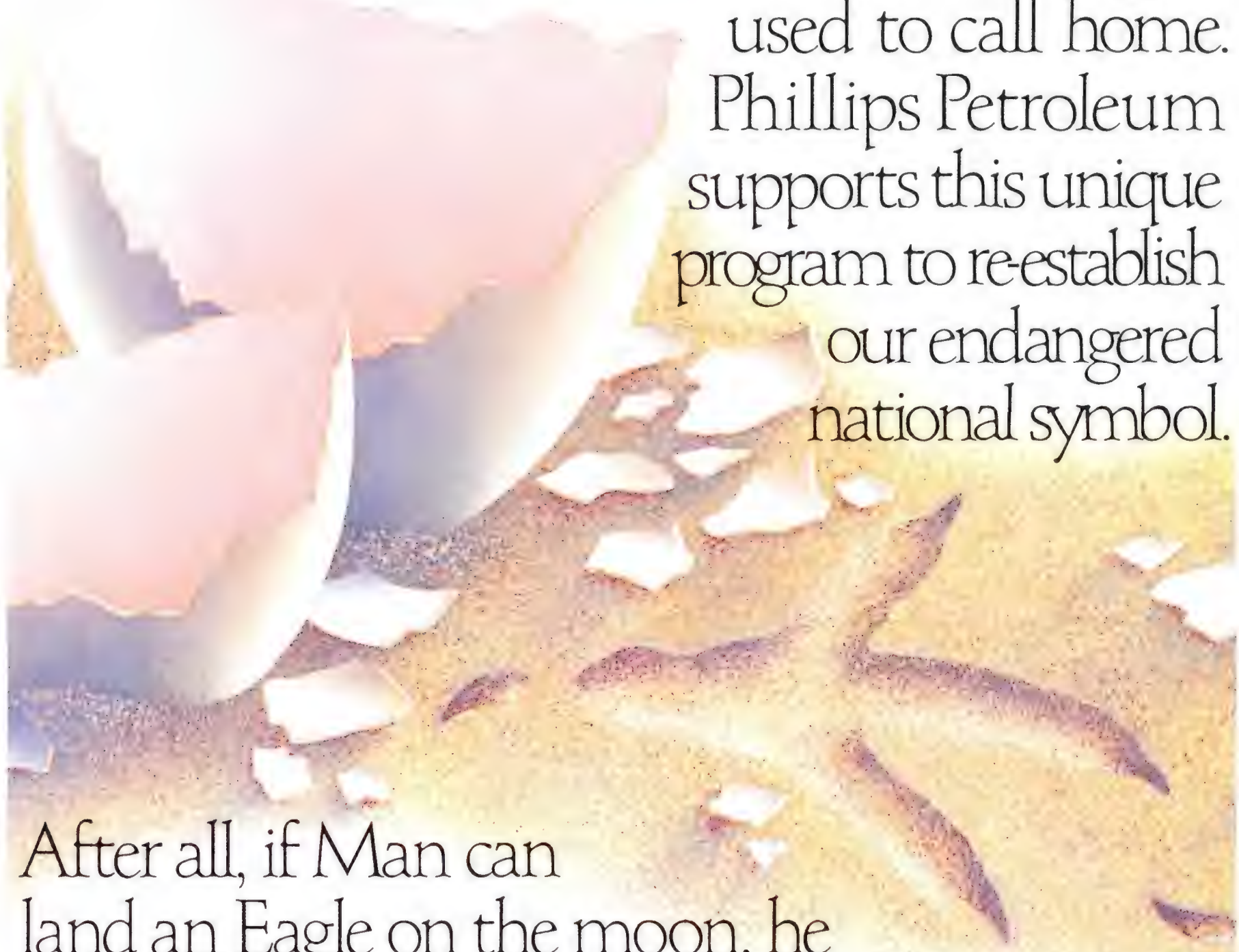

After all, if Man can land an Eagle on the moon, he can surely keep them landing on the earth.

PHILLIPS 66

For more information, contact the George Miksch Sutton Avian Research Center Inc., P.O. Box 2007, Bartlesville, OK 74005, (918) 336-7778.

Jim Williams has safeguarded his riverfront farm by selling future development rights to Massachusetts.

tions, and this house takes up 160 feet of riverfront, a little more than half the length of a football field. The town of Lyme, Connecticut, approved the 4-acre building site years ago; in exchange for that, the owners granted a perpetual easement on the adjoining 17 acres to a local conservation trust. Someone pointed out last year that the house appears to block one of Lyme's only access roads to the river. But public access points are considered a nuisance; they bring in outsiders. Townspeople voted not to pursue the issue.

"That takes care of the eagle roost," said Zickefoose, surveying Selden Neck from the No Trespassing sign at the top of the driveway. "See that tree over there, the feather-duster shape? That's where the bald eagles hung out. It's a wonderful place for hawk-watching in the fall. Merlins sit up here on the cedars, and sharp-shinned hawks." She listened to the new music of hammers and circular saws. "So much for that."

Upriver in Massachusetts, Jim Williams can get as passionate about dirt as Zickefoose is about birds. He's a mild 66-year-old who keeps 170 head of Holsteins on his riverfront farm in Sunderland. "It's excellent soil. Hadley loam. It's a fine sandy loam, very well drained. You can go out and plow right after rain. You can grow anything on it. We claim we can get as much tonnage as they can in any part of the country in corn, vegetables, whatever. There are no limits here. It shouldn't be used for anything else."

Who's going to speak for agriculture?

A few years ago, Williams sold the development rights on his land to a state farm-preservation program, insuring that his family, which has farmed here since 1775, can continue to keep the land in agriculture. But money for such programs is hard to come by now. I mentioned a nearby field where a subdivision was just going in.

"Oh!" Williams said, his eyes closing and his mouth dropping at the thought of lost ground. "We were renting it. There was alfalfa there. We harvested the first crop, and then the bulldozers came in. Beautiful soil! The sad part of it is, there wasn't a person who got up in town to speak for saving the land."

It was at this point that pessimism started getting to me as it had to Evan Griswold—at the thought of all the new septic systems reviving the coliform count, and of all the new riverbank lawns leaching fertilizer and pesticides into the river, gradually turning it back into a sewer. At the thought of suburban sprawl eating up farmland, wildlife habitat, public landscapes and the local sense of place. So I looked around for some hint that people might still somehow prevent the undoing of the countryside, and thus I found myself one day in a cul-de-sac in South Hadley, Massachusetts, at the other end of a tape measure from a regional planner named Randall Arendt. He is the head of planning at the Center for Rural Massachusetts, a research group at the state university in Amherst that is charged with finding ways to preserve the agricultural landscape. He thinks it's possible to design subdivisions that provide needed housing without gobbling up the open countryside.

The usual remedy for sprawl is to mandate larger lots, but Arendt says this only leads to more sprawl. In a design manual called *Dealing with Change in the Connecticut River Valley*, he and his coauthors argue for smaller lots arranged in a number of different configurations that preserve open spaces. One of these clusters the houses close to the sidewalk in the classic New England village pattern. It is, Arendt suggests, a good way to free up a substantial chunk of a subdivision as permanent, usable open space for farmland

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At General Motors, we recognize the effects that cars and their manufacture have on the environment. We understand the relationship better than any other carmaker in the world.

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Our dedication to environmental improvement has been applied with similar success to the process of building GM cars and trucks. We have reduced plant emissions and made more efficient use of energy in all of our facilities.

- **We are using electrical energy more efficiently in our plants—since 1972, we've reduced usage by 44% per vehicle produced.**
- **The use of new paints has lowered hydrocarbon emissions at our assembly plants by 70% since 1977.**
- **GM is committed to using non-CFC air conditioners in all our vehicles by 1996, and we are eliminating CFCs from manufacturing processes as quickly as possible.**
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In 1989, GM scientists were honored for their work on air quality by the American Meteorological Society. This year, people throughout the corporation—in our plants and offices as well as in our labs—are showing their support for Earth Day 1990. It is a day for gaining some measure of how far we have come, and how far we have yet to go.

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or parks. In many of his group's other design schemes, the houses tend to be tucked away innocuously in the wooded corners of fields, leaving the open, uncluttered countryside intact.

The riverfront in South Hadley is a good place to get a sense of how urgently the valley landscape needs what Arendt calls "mandatory open space development." In the late 1970s, using Clean Water Act funds, the town ran an extracapacity sewer intercepter through the rural countryside here, encouraging builders in the same way a widened highway draws new traffic. Last year, 180 new housing units were going in along a mile-and-a-quarter strip of former farmland. To Arendt, the houses set in the dead center of their one-acre lots looked like lonely fiefdoms, and the wide new streets seemed ideal in case four school buses ever tried to get through all at the same time. The landscape itself could have been almost any place other than the Connecticut River valley, and even the cop giving out speeding tickets to his new neighbors was dismayed. "I moved here six years ago," he said. "It used to be a nice place."

From the people, reasons to nurture hope

The Arendt group's design manual has aroused considerable excitement in the valley—as well as some criticism. Naturalists generally like its proposals but argue that they will work only in the context of an overall plan to protect important natural areas from even the most enlightened development. Arendt finds himself giving 150 or so speeches a year to variously eager and skeptical groups, and a few communities have begun to adopt open-space ideas, including riverfront buffer zones and construction setbacks. People are increasingly willing to accept such restrictions, in part because the public has invested heavily in the river landscape. Such limitations also appeal to property owners because they prevent one guy from building his Villa Vulgaria in the middle of another guy's cherished view.

Early this year much of the lower valley rose up in outrage when a New Jersey company proposed to build a trash-burning plant with a 250-foot smokestack on the river. The idea lasted only three weeks before apparently succumbing to local protests.

Happily, there are additional reasons to nurture hope for the Connecticut River valley. Terry Blunt and his counterparts in other state programs continue to buy and preserve land, as does the Nature Conservancy, which has begun a $10.3 million program to protect important natural sites throughout the valley. When we talked, Blunt was trying to create a green barrier-strip across the top of Northampton, an instance of the useful conservationist tactic known as checkerboarding: if you can't afford to buy the whole site, buy the access point, putting the rest of the property out of reach of developers. Blunt ran his hands over a topographic map like a field commander planning a holding action in a larger war. If he failed to assemble a green barrier here, he said, indicating the edge of a huge open area, some developer would "put a loop-the-loop here, and then another loop-the-loop here, and pretty soon you're in Whately," two towns to the north. If Blunt succeeds, he will turn development back toward the city and preserve a large undeveloped area along the river where black bears still live.

Holding actions aren't a permanent answer, of course. The permanent answer is to revise our entire approach to land-use regulation, so that instead of fostering sprawl we prohibit it, and thereby safeguard the common resource of landscape and wildlife. As Abe Ribicoff suggested, it was folly to have begun the river cleanup 18 years ago in the absence of any control over the changes it was bound to produce. But back then people didn't understand the forces they were unleashing. They suffered from the all too familiar idea that farsighted land-use regulation was somehow, well, un-American.

That attitude seems to be changing now, and when I look out at the river and at the yellow afternoon light on its wooded banks, and when I listen to people like Arendt and Blunt, it seems that the change has not come too late. There is still plenty to celebrate here, and there is still plenty to protect. Eighteen years ago, almost everybody was pessimistic about the Connecticut River, and yet they managed to turn a dying waterway into a 400-mile natural wonder. If they could fix "the sewer," isn't it reasonable to think that, with care and a little sacrifice, we can figure out how to save the landscape, too?

Mist shrouds a graceful old bridge between Fairlee, Vermont, at left, and Orford, New Hampshire, less than 80 miles from the Connecticut's headwaters near Canada. Here traffic is sparse and nature's in charge.

WHITESIDES

Do we really want to return to those good, old-fashioned days before plastics?

America is coping with the problem of too much garbage and too few places to put it.

Our nation is currently generating about 160 million tons of garbage a year. Our landfills have decreased from 18,500 to 6,000 during the past 10 years. About 2,000 more will close within the next five years.

Some people believe that banning plastics and substituting other materials will solve the problem. We don't think that they have all the facts.

If plastics were banned, we'd lose safety and convenience features such as closures for foods and medicines, shatter-resistant bottles, freezer-to-microwave packages, and wrappers that preserve food freshness.

A 1987 study shows that if paper and other packaging materials were to replace plastics, the energy needed to produce the packaging would double, the weight of packaging would increase four-fold, the packaging cost would double, and the volume of waste collected would increase about 2½ times.

Myth vs. Reality.

The thinking behind a ban on plastics is based on a number of myths.

Myth #1 is that plastics make up a major part of our solid waste. Fact: according to a recent study, plastics make up about 18% of the volume of solid waste in our landfills; paper and paperboard about 38%; metals, 14%; glass, 2% and other wastes, 28%.

Myth #2 is that paper and other products commonly considered biodegradable will decompose in a landfill, so it takes longer to fill up. Fact: recent excavations of some landfills have turned up newspapers buried 40 years ago—still perfectly readable.

Myth #3 is that plastics are not recyclable. Fact: plastics are among the easiest materials to recycle. 20% of all plastic soft drink bottles were recycled in 1987.

Recycling takes plastic items destined for disposal and turns them into useful new products. It can turn plastics into a "natural resource."

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At Amoco Chemical, we believe the solution must integrate recycling, source reduction, environmentally secure landfills and waste-to-energy incineration. Everything recyclable should be recycled—yard waste, paper, glass, metal and plastics.

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We're participating in a consortium with other major plastics manufacturers involved in the construction of regional polystyrene recycling plants.

We're encouraging the start up of new recycling efforts, helping to find better ways to collect and sort recyclables, and supporting efforts to create markets for products made from recycled plastics.

At Amoco Chemical, we believe that recycling can play a major role in helping America solve its solid waste problem. Before we decide to return to the past, let's remember that the good old days were sometimes the not-so-good old days.

For a free copy of "Recycling. Do It Today For Tomorrow," write Amoco Chemical, Recycling SS, 200 East Randolph Drive, Chicago, IL 60601.

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By Don Moser

One more chance at survival for the cloud runners

At Idaho's World Center for Birds of Prey, peregrine falcons and other endangered raptors are raised for reintroduction into the wild

The Center nestles in hills near Boise. Falconers, city, Bureau of Land Management, helped in acquiring site.

Streamlined, broad-chested and powerfully taloned, female peregrine (opposite) exemplifies the species.

In a brushy ravine behind his house in Boise, Idaho, Morley Nelson, wearing a cowboy shirt and a pair of beat-up combat boots, stomps around among his birds of prey, bestowing a duck head here and a goose neck there, and talking more or less simultaneously and without distinction to his birds and a couple of visitors. "I envy you, big hawk," he croons to Thor, a white gyrfalcon so elegant in form that it must have been made on one of God's better days. When a soft whistle floats down from an enclosure up the hill, Morley whistles in response. "The eagles are saying hello to me—they talk to me night and day." He leads his visitors up to meet a huge white-headed bird. "That's Pearl, the bird that delivers the mail. She's on the Express Mail package and in the TV commercials. She was sent to me after she got shot in Minnesota."

Morley moves on, greeting Charley the prairie falcon, a sleek bird shaped like a lawn dart, and finally a red-tailed hawk that raises its hackles until it appears twice its normal size. "You don't want to take chances with this one or you'll get a thrill right through your hand." He moves slowly forward with the glove ex-

Photographs by Terry Domico

tended. "Come on, big hawk," he says quietly, then lifts the bird, offers it a chicken neck.

"They have this singular philosophy. They say, 'Brother, if it comes to fighting, it's gonna be you or me.' If you put a hand on her chest she'd take you with both feet and her beak, and you'd have to fight her to the death. That's why people who know them say, 'Man, if you gotta die, that's the way to go.' "

To argue that Morley Nelson is daffy for raptors is to understate the case. As a boy growing up on a North Dakota ranch, he acquired a young red-tailed hawk and became entranced by it. His obsession grew over decades spent as a hydrologist by trade and a falconer by calling, as a wildlife cinematographer and a formidable advocate for anything with talons.

There is nothing unique about Nelson's infatuation with birds of prey. With their lethal grace and indomitable courage, hawks and falcons have always inspired a near-fanatical admiration on the part of those who know them. It is understandable, then, in this day of widespread concern over endangered species, that the most sustained and successful effort to save wild creatures has been launched on behalf not of elephants or whales or baby seals, but of raptors. The locus of this effort is in Boise at the World Center for Birds of Prey.

The Center is the product of a number of forces and forceful people, including Morley Nelson and Tom Cade, the ornithologist who pioneered the captive breeding of raptors and developed procedures for introducing them into the wild. While a professor at Cornell, Cade established a support organization called the Peregrine Fund and started a reintroduction program around the country, which ultimately led to the creation of the World Center in Boise. With Cade as chairman and Nelson as vice chairman, the Center has acquired a remarkable momentum.

A conservative Western state whose ranchers and farmers are not by nature given to looking with favor on predators of any kind, Idaho has nevertheless taken the birds of prey under its wing. The Center depends heavily on private contributions, and its list of major donors is salted with the names of Idaho corporations such as Boise Cascade and Ore-Ida Foods. Donations also account for much of the plant and equipment, from the flagpole (courtesy of First Security Bank) to the vehicles (courtesy of the Idaho Power Company and Intermountain Gas).

The Center works with endangered raptors from around the world, but its greatest successes have been with peregrine falcons of the United States. The peregrine is the art of bird design carried to perfection. Broad-chested, streamlined, scythe-winged, it can fly

At age 15, Don Moser, Editor of SMITHSONIAN, *had a pet kestrel that liked to awaken him by biting his ear.*

Morley Nelson, a falconer and raptor conservationist, converses with a friend—a young great horned owl.

at 80 miles an hour and dive at 200. Its eyes are eight times keener than those of a human and, like zoom lenses, can instantly change focus as it closes on its prey. Once, peregrines nested on high cliffs from the Hudson Palisades to the Sierra Nevada, even occasionally adapting to urban centers, where skyscrapers substituted for granite cliffs and city pigeons proved adequate stand-ins for mallards and mourning doves. But with the widespread use of DDT and other man-made chemicals, peregrine numbers plummeted during the 1950s and '60s. By the end of the '60s peregrines were extinct in the Eastern United States and in the West were reduced by 90 percent.

Today, because of the work of the Center and associated institutions, the picture has changed dramatically. Thus far, the Peregrine Fund has released 3,000 captive-bred peregrines and established 300 nesting pairs in the wild. If things continue to go well, by 1995 the Center will have established nucleus populations of peregrines throughout their original range—an accomplishment that, in the short history of Man's attempt to rescue endangered species, is astonishing.

Less imposing than its name, the World Center is a sprawl of one-story, functional buildings on a piece of windswept sagebrush desert near the Boise airport. There, Bill Burnham's office is a kind of magpie's nest, littered with the detritus of a life spent knocking

Tom Shanahan

Bill Burnham prepares young falcon for hacking atop Boise office building. Bird will feed on city's pigeons.

Ornithologist Tom Cade, Center's chairman, examines a healthy double-handful of Mauritius kestrel chicks.

around the hinterlands of several continents: spear points, a stone ax, an ostrich egg, a few animal skulls, porcupine quills, antique firearms. Burnham is a biologist and an outdoorsman, but today he is wearing the uniform that he dons when he plays the role of president and CEO of the Fund and director of the World Center, and he looks mildly uncomfortable. "It's the first time I've ever done a release wearing a suit and tie," he says dryly.

Burnham has spent the morning on the roof of the second-tallest structure in Boise, the 12-story Key Bank building, installing three robust young peregrines in a "hack box," from which they will be released in a few days so that they can learn how to fly and how to hunt down the city's numerous pigeons.

Back in his office now, Burnham sheds his suit coat and looks relieved. "In high school I was failing biology," he says. "Someone caught a couple of baby great horned owls, and the teacher gave me one and got a girl to tutor me. He gave me a bird and a woman—a life." A few years later, Burnham, by then a totally addicted falconer, and his wife and former tutor, Pat (now the administrator of the Center), alternated working and putting each other through school. While earning his PhD, Burnham went to work for Tom Cade's Peregrine Fund. "We had the incubators in the bedroom and the brooders in the kitchen," he recalls.

These days no one at the Center keeps incubators in the bedroom, but in the case of Cal Sandfort one can't be too sure. A soft-spoken, bearded young man, Sandfort runs a falcon factory, and to spend an afternoon with him is to get a sense not only of his ferocious commitment but of the precision with which the breeding program is carried out.

It is noon. Cal, at work in his laboratory, is surrounded by incubators and brooder trays and a wall-size battery of television sets through which he can monitor the 60 breeding chambers out in the hawk barns. At the moment, he is hunched over a small scale, weighing eggs. The eggs, he explains, must be weighed every third day. To make room for the growing chick during incubation, an egg should lose about 17 percent of its weight by evaporation through the shell. Cal places a heavily blotched peregrine egg on the scale. "This should lose 5 grams over 31 days," he says, and punches up some numbers on a calculator. "That means .485 grams over 3 days. This one weighs one-tenth of a gram less than it should, and so we want to slow down the weight loss." Cal returns the egg to a different incubator—one with a humidity of 40 percent rather than 30 percent. If the weight loss is much too slow, he explains, he may sand the eggshell to increase evaporation. "At the height of the season we may handle 120 eggs at a time. Then you work 24 hours a day."

For endangered raptors, another chance

Glen Eitemiller

Imprinted male falcon copulates with Cal Sandfort's hat, designed to collect semen for insemination.

Cal checks another incubator, marked "pre-pip." One of the eggs has a small hole punched in its side. At 31½ days the embryo needs air but isn't strong enough to break out. It pips a breathing hole, then, after 48 to 60 hours, begins to chip a circle around one end of the egg, "just like opening a can." That is happening now, at 1:57 P.M.

While the chick pecks away, Cal prepares a bowl of "mush." The Center raises 120,000 Japanese coturnix quail a year, and each morning a supply of these is ground into a kind of quailburger. For the first few days after hatching, chicks live in brooders, shallow, towel-covered trays that contain heating elements. Cal removes a towel, leans over a brooder and makes a cheeping call that mimics the sound of an adult peregrine. Instantly, five little fuzzballs are up, beaks agape, cheeping for food. They are all mouths and bulging eyes and oversize feet, ugly to the point of being endearing—until you realize that it is just those beaks and eyes and feet that will make them, as adults, such awesome killing machines.

Hungry chicks and sleepless nights

Cal moves from brooder to brooder, feeding each chick in turn from a pair of forceps. The chicks are fed six times a day, including feedings at 11 P.M., 2 A.M. and 5 A.M., and Cal handles all of these. "I have an uncanny ability to get along with little sleep, and if I don't get up and come over, I lie there and worry. Sometimes one chick will hatch, and then another, and people are coming into the office in the morning and there you are with little or no clothes on, and you have to run back for your pants."

It's 2:27, time to check on the pipping chick. In just half an hour the chick has opened its "can," and lies there damp and naked. Cal swabs the sphincter with alcohol to guard against infection and places the chick next to the heating element in a brooder incubator insulated by two towels. After 10 to 12 hours Cal will give the chick its first meal of quail mush.

Three o'clock, and now, with his assistant Glen Eitemiller, Cal is going to introduce some chicks to their peregrine foster parents. Since the chicks' needs vary with their ages, and since the care provided by adults varies, too (according to the rhythms of their nesting cycles), chicks and parents must be closely matched. The result is a game of musical chairs. Today, five 10-day-old chicks from the brooder will be given to an adult pair of falcons. The 15-day young they have been caring for will move to another chamber and another set of foster parents, whose five 30-day young will be removed to release sites in the Idaho mountains.

The hawk barns are dark, smelly places. Each breeding chamber has a large, barred window to admit

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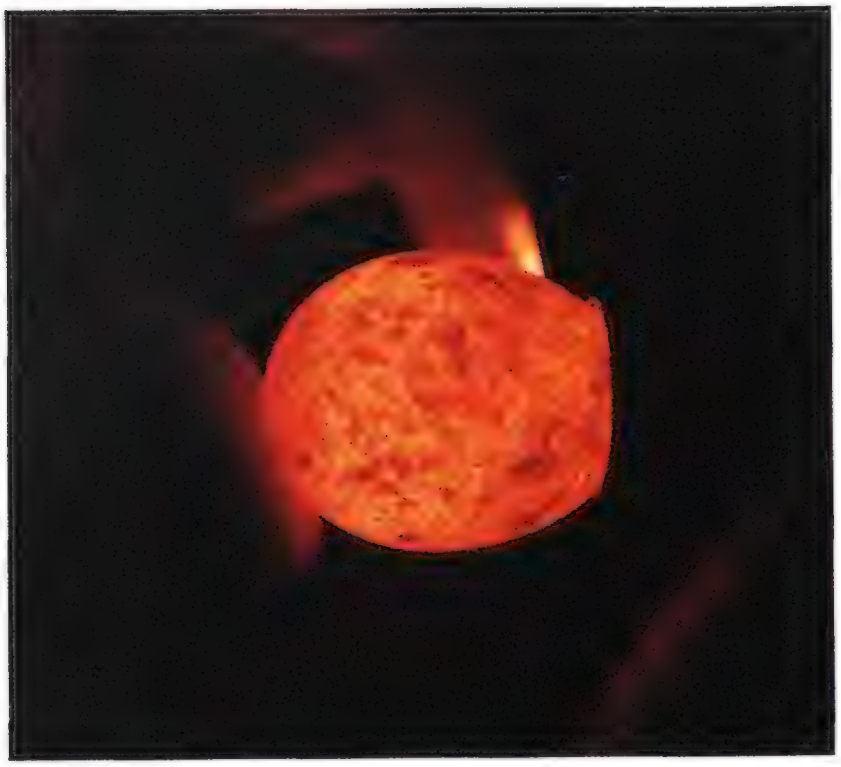

At top, Cal Sandfort candles egg to check on embryo, then feeds quail "mush" to peregrine hatchling. Below, at left, a chick struggles from its shell. The downy chicks are later color-marked for future identification.

light and air, but the staff avoid these to keep from upsetting the volatile birds. As Cal and Glen enter the barn through a central passageway, piped-in music serves to disguise the sound of their footsteps. Cal, carrying a long-handled fishing net, enters the breeding chamber through a door at ground level. Glen climbs a stairway to the upper level of the chamber and crawls out onto the nest ledge, about 15 feet above the floor. And all hell breaks loose.

The two adult peregrines go into a frenzy, screaming, ricocheting off the walls. Down below, Cal deftly nets the female, puts her to the floor, nets the male and grounds him also. "It seems wrong to be netting peregrines," Cal will say later, "but it's better than having them slamming into the walls. And they can get you, too—they can be real ornery."

While Glen removes one set of chicks and replaces them with others, Cal stands guard with the net. On the floor the two adults waddle about, screaming. They do not seem to belong on the ground, big-footed and clumsy there, massive across the shoulders, looking like zoot-suiters in padded jackets.

With the new chicks in place, Cal and Glen move on to another chamber where the scene is repeated, bedlam once again, Cal wielding his net like a lacrosse player. Then, the final transfer, the removal of fully grown young. These birds are feathered out, with impressive-looking talons to which attention must be paid. All raptors have powerful feet, and falconers speak of being "footed" when a dyspeptic bird has a go at them. Glen, unfortunately, has forgotten his glove, and it takes him a long time to get the five feisty young birds into the carrying container. He pulls it off with only a pinch from the talons. The secret? "Move very, very slowly," he says.

Back in the lab, Glen's five young falcons are tagged for future identification in the wild. At 5 A.M. three of them will be driven to the Centennial Valley in Mon-

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Feisty fledgling peregrine is boxed for transport to a hack site. Within a week or so, he'll be flying free.

tana, where they will be placed in the nest of a breeding pair of wild peregrines whose eggs have failed to hatch. One hour later, the other two young falcons will be flown to the Colorado part of Dinosaur National Monument, where they also will go into the aerie of wild peregrines that had nesting failure.

With the young birds packed for shipping, Cal checks the television monitor for chamber 26, where the 10-day-old chicks were introduced to their new foster parents. On the screen, the adults are feeding the young ones. "All fine," Cal says.

It is 5:30 P.M., quitting time for most people. But two more groups of birds still must be removed from the hawk barns, banded and prepared for shipment to sites on the Columbia River. Cal has pipping eggs to check, young to feed at 11 and at 2 A.M. and 5 A.M. At 6 in the morning, Cal will drive the Dinosaur Monument chicks to the airport.

Most peregrines will successfully mate in the Center's breeding chambers, but falcons are high-strung creatures, and artificial insemination is sometimes called for. This involves a relationship between man and bird that seems, well, extraordinary.

To be prepared as a stud (called a "hat bird" for reasons that will become clear), a young male is reared and hand-fed for between 30 and 40 days, by which time the bird regards its handler as another falcon or itself as a human, and would regard another peregrine as an alien being. When the bird reaches maturity at 2 to 3 years, courtship begins. In the hawk barn, Cal enters a chamber where one such imprinted male is perched on a feeding ledge. Cal kneels to be on the same level as the falcon, and proffers a piece of quail breast. The falcon accepts it, plucks a few feathers from it and offers it back. Cal holds the meat for a moment, then returns it once more, reenacting the food exchange that is a part of peregrine courtship ritual.

The falcon then bows its head and utters a series of piercing cheeps. Cal bows and cheeps in return, just as a smitten female would, and for the next few minutes the two of them provide an amazing spectacle, man and bird bowing and cheeping, affectionate lovers arousing each other.

Finally, the hat—a nondescript fedora with a rubber dam around the crown to catch the semen. With the male fully aroused, Cal will don the hat and turn his back (the male peregrine mounts the female from the rear). The male then flies to the hat and, with much cheeping and fluttering of wings, copulates with it.

The aim of the breeding program, of course, is to reestablish breeding populations in the wild, and this is usually accomplished by a procedure known as hacking back. The young peregrines are transported to wilderness hack sites and placed in large, barred wooden crates. At each site are two attendants who can be likened to baby-sitters. During the first week, the birds remain caged, while the sitters provide them with frozen quail to eat—but are secretive in how they go about it. In order that the birds do not imprint on humans, the sitters try to remain invisible, dropping the quail through a tube in the back of the box.

Learning to hunt by trial and error

After a week the bars are removed so that the birds can begin their first flights. Although a young falcon cannot be taught how to hunt, it does have to learn through trial and error. In nature, during those first weeks as the young falcons try to connect with their prey and dispatch it, the adults continue to feed them. During hacking, the baby-sitters play the same role, leaving quail at the hack box early each morning, so that the falcons can count on a square meal even if unsuccessful in their hunting.

The sitters also provide some protection from predators. Golden eagles—almost as fast and maneuverable as peregrines but much larger—can clean out a hack site in a few days, but the sitters can discourage them by banging pans or shooting off flare guns. At night, great horned owls are an even worse menace. "The owls will come back every night until they've killed them all," says Bill Burnham.

One afternoon Bill visits a hack site not far from the town of Cascade, about two hours north of Boise. The site is on land owned by Boise Cascade, the timber company. After a half-hour drive up a steep, twisting logging road, Bill pulls off near the summit of Grouse

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On Idaho's Grouse Peak, Tammy Ferreira climbs to hack box to put out extra food for young peregrines.

At camp nearby, Tammy maintains log while Denise Boggs uses scope to keep birds under observation.

Peak and walks down the brushy hillside to a little campsite, where a couple of brightly colored tents are pitched beneath a ponderosa pine.

The baby-sitters are young women, Tammy Ferreira and Denise Boggs (about half of all the hack sites are "manned" by women). The first subject to be discussed is the weather, which has been terrible—rain and snow and hail. The zipper on Denise's tent is broken, and the camp stove is broken too. Neither of these inconveniences seems to concern the baby-sitters much, and Bill Burnham says cheerfully, "They get to work for two months, seven days a week—we pay them almost nothing, and at the end they get to keep the leaky tent and the stove that doesn't work."

Tammy has a bachelor's degree in biology and has worked for the Colorado fisheries department, evaluating stream habitat from aerial photographs. Denise has just graduated from Montana State as a major in political science, with emphasis on environmental affairs; in previous incarnations she has been a firefighter and a river guide. Both women seem comfortable with their isolation. They have kept notes on the 30 species of birds they have seen on the mountain, in addition to the visiting elk and coyotes. A neighborly marmot whistles at them from nearby rocks, and an utterly fearless ground squirrel named Rusty patrols the camp as if he owns it. Rusty shows signs of squirrel wars past—he's scarred and has a hole in his ear. "We wanted to put an earring in it," Tammy says.

"It's peaceful here," Tammy continues. "But you have to spend 16 hours a day looking through that thing." She points at a spotting scope aimed at the hack box, on a rock outcropping 300 yards away.

Baby-sitters, proud but worried

Released from the box nine days ago, the four young falcons are roosting in nearby cliffs and trying to hunt for themselves. Each morning Tammy climbs the tower to place quail on top of the box. Periodically during the day, the birds return to feed, while Tammy and Denise keep them under observation with the spotting scope and take notes in their logbook (left). A glance through the log reveals both their pride in the birds' progress and their worries: a golden eagle, a wild peregrine and a prairie falcon in the area, any one of which might attack their young charges.

Now, in the sky beyond the hack box ridge, something flickers in the air, a mote growing quickly larger, a deep-chested shape, long wings cutting. Astonishingly fast, it rips a curving slice across the air, then, almost daintily, drops to the rocks near the hack box. One of the young falcons has come home.

A falcon flying free is one of nature's stunning sights —"the achieve of, the mastery of the thing," Gerard

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Manley Hopkins wrote in wonder. Birds of prey are the ultimate wild spirits, wind wild, crazy wild. To see them caged, restrained, as they are at the World Center, being brought to the ground in nets, is disturbing. Equally disturbing to some is the sport of falconry itself, for the birds, while never really tamed or dominated, are maintained in a kind of voluntary servitude—mercenaries, as it were.

Yet nearly all of the Center's staff, and many of its volunteer workers and supporters, are or were falconers, and it is primarily because of them that the peregrines continue to exist at all. "The falconers had the strongest motivation to see this done," says Tom Cade. "It's not a 9-to-5, 40-hour-a-week job. You needed people who were almost zealous."

Thirty miles south of Boise lies the Snake River Birds of Prey Area, a 482,640-acre refuge that contains the greatest concentration of raptors in North America, if not in the world. The core of the refuge was established in 1971, largely as a result of Morley's incessant lobbying and badgering. For years he stumped the state of Idaho accompanied by his props—a golden eagle or a handsome falcon on his fist—cornering government officials, addressing farmers and ranchers, extolling the magnificence of the birds and allaying concerns about the damage they cause. (In one bit of theater he would tie an eight-pound weight—the heft of a lamb—to the feet of his enormous eagle Cleo and demonstrate how the bird could not lift it from the ground.) Perhaps because he's a Westerner, a man who can break horses, a dead shot who last wore a necktie 20 years ago, people listened.

One day Morley and Bill Burnham escorted a young couple, contributors to the Peregrine Fund, on a boat tour of the refuge. The presence of the natural area was a factor in the selection of Boise as home for the Center, and it serves now as a kind of outdoor laboratory and classroom where the public—and financial supporters—can be introduced to birds of prey in a natural setting.

The Snake, broad and slow-moving here, flows through a narrow gash cut into an ancient lava flow. Steep slopes of gray-green sage and yellow greasewood rise to vertical cliffs of black basalt. There are no trees except for an occasional clump of small willows along the riverbank. A hot, gusty wind blows upstream, pushing the inflatable against the current. In the stern, Bill Burnham runs the little outboard. In the bow, Morley, voluble as always, talks geology. Bill beaches the boat from time to time, and the party climbs to the cliff bases. Morley rummages in scree. "Indians used this place," he says, coming up with some fragments. "See the mussel shells? This is a piece of buffalo bone, maybe. They busted it to get the marrow out."

Around a bend in the river, Morley points out a prairie falcon aerie, a rough niche in a ledge 200 feet above. On ledges nearby he spots two, then three, then four, and finally a fifth young falcon. They stand like little statues against the rock.

Then a staccato *cack-cack-cack* echoes through the canyon, and a brown shape hurtles along the cliffs. It is the tiercel, the adult male. One of the young falcons launches itself and tries to rendezvous with its parent, and the adult puts on a show then, rolling and stooping on the youngster. "Look at him," Morley exults. "He's saying, 'Get back there, you little squirt.'" The tiercel rifles off down-canyon, pulling the eyes after it, breathtaking in its speed.

Later, back at the boat ramp, Morley talks about the continuing battle to preserve the refuge from one kind of disruption or another—shooters, who kill dozens of raptors each year; farmers, who want to put nearby marginal lands into agriculture; the National Guard, which wants to use land along the river as an artillery range. "The battle never ends," he says. "But when you see what we have done with the peregrine, what we're doing with the teita falcon, the Mauritius kestrel, you see we've made some progress. And we can share it with people. With kids who need to feel a part of the Universe. When I bring people down here and see the smiles on their faces when they see a falcon or an eagle, I feel nothing but good.

"You know," he goes on, "it's stipulated on this planet that you have to survive. But you have to go beyond that—to some wisdom."

High above the Snake River, in a special refuge for birds of prey, a golden eagle keeps a sharp lookout.

George Silk

OUR FIRST SUBMARINE DID ONLY ONE REMARKABLE THING. IT CAME BACK UP.

John Holland invented the first submarine accepted by the U.S. Navy. Amazed reports said, "She goes like a fish and dives better than one."

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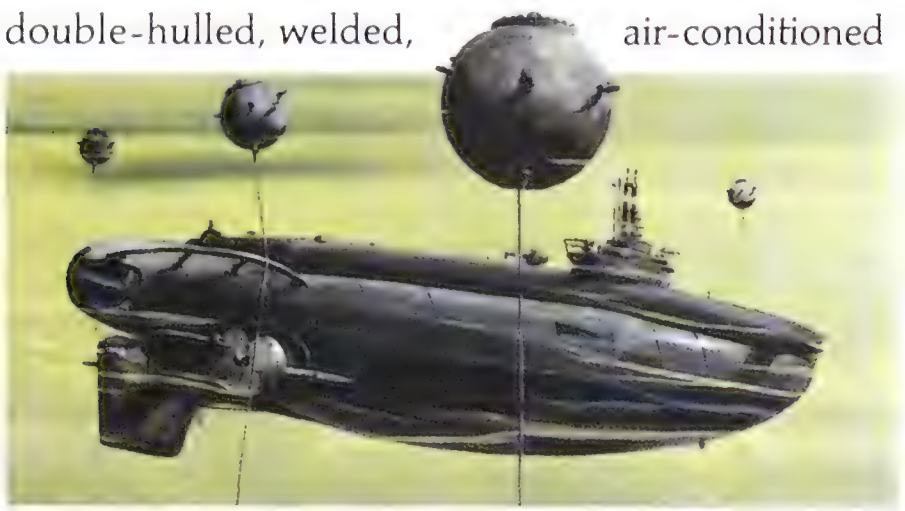

All WWII fleet submarines were based on Cuttlefish, the first submarine to be welded, rather than riveted, and a technical milestone.

USS Helena, 688-class submarine.

submarine. She was the prototype for all World War II Navy fleet submarines.

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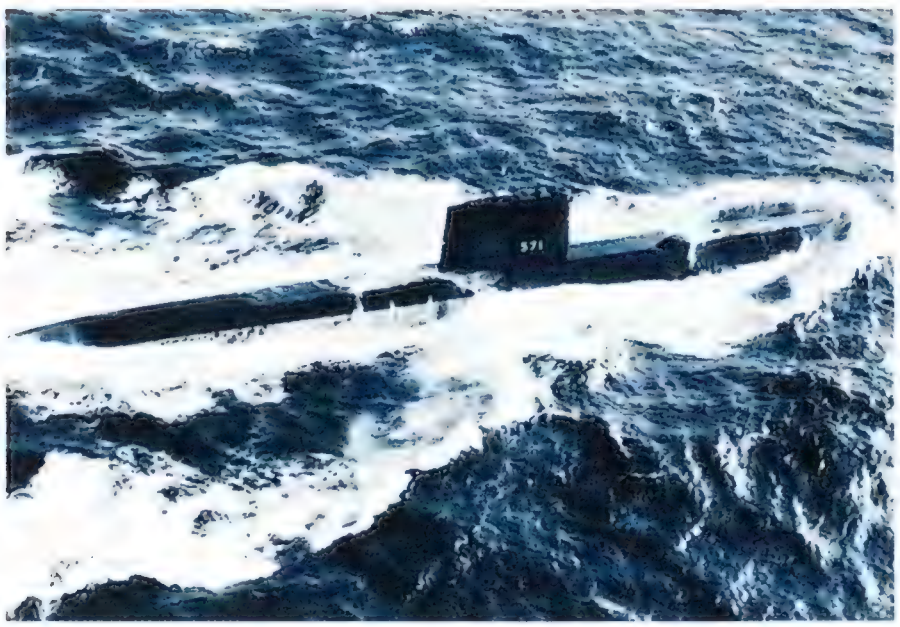

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Dedication to both has kept us improving American submarines for 90 years.

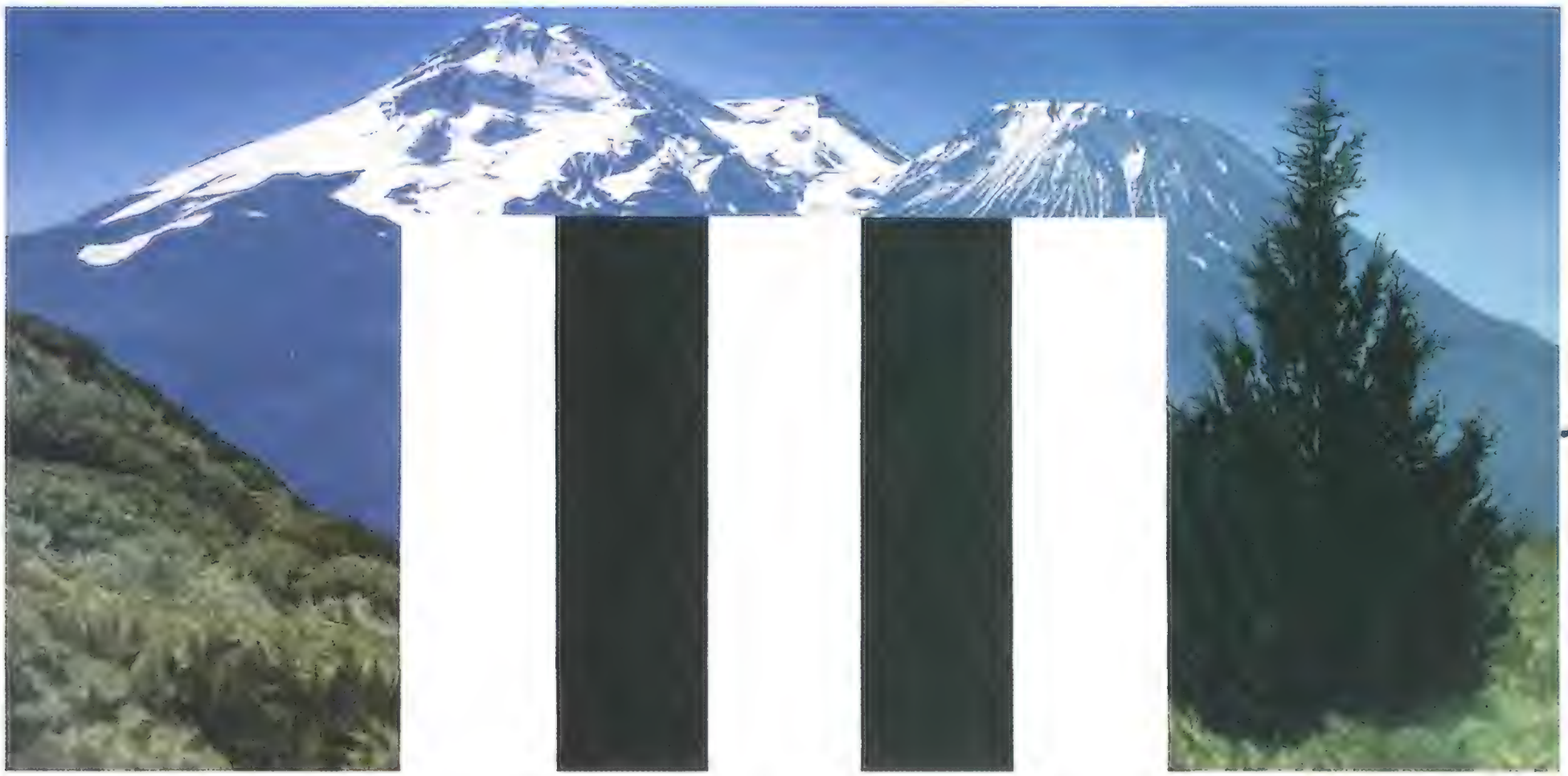
GENERAL DYNAMICS

A Strong Company For A Strong Country

By Michael Kernan

A new generation of artists ponder nature's prospects

Church and Bierstadt saw a landscape that seemed limitless and wild, but today the heirs to that tradition have a different vision



Proprietary View: Mount Shasta, 1985, was painted not from nature, but from a photograph reproduced in a book—which, like the vertical bars, says artist Don Suggs, stands between us and the real thing.

Here's a magnificent picture-postcard painting of Mount Shasta—nearly half obscured by a rectangle of vertical bars that is plopped, like a No Trespassing sign, squarely in front of it.

How about these elegant winter trees against a cold lemon sky? Uh-oh: on all four edges the painter has left masking tape. Wait. It's not masking tape, it's a trompe l'oeil, deliberately painted to look like tape.

Now *this* superbly painted little one, no bigger than a sheet of typewriter paper, is a proper landscape—except that it's practically strangled by a frame as big as a horse collar. Here's another one, painted on cinder block, if you can imagine, and set into a base the size of a lectern, made of plywood faced with metal laminate. And over here, these weeds that seem to be growing upside down, with miles of sky . . .

Artists are the antennae of the human race. They sense the changing realities of our lives before the rest of us do, which is why they so often conflict with the Establishment and other defenders of the status quo. You want to know how the next generation feels about the environment? Look to its artists. As it happens, the

Joan Nelson's 12-inch-square *Untitled #227* (1988) depicts the sky as seen through the mouth of a cave. She "aged" the work with layers of sepia varnish to remind viewers that this is a painting—not nature.

landscape is very big in American painting right now. And the message is there for anyone to see. Maybe "message" is the wrong word, for the connection is subtle.

"My work is not about landscape," insists Tracy Grayson, standing before three giant paintings of mountains in his TriBeCa loft in New York. "It's not about the environment. I mean them to be abstractions. About nothing. About being a painting." So it is not a good idea to talk to these painters about the "new landscape painting," because every one of them will fiercely deny there is such a thing. And even if there were, they add, they wouldn't be part of it. And they are right: the differences among them are dramatic. Yet it is possible to draw some interesting conclusions from studying these determinedly individual works.

"They don't get together and talk, the way the Abstract Expressionists did; they've hardly even met each other," says Suzaan Boettger, a New York art critic and freelance curator who has organized several landscape shows. "A lot of them paint on thick panels to emphasize that this is an object, not a vision that you feel you can step into and merge with."

In other words, even as they remind you of the great classic American landscape artists—Church and Bier-

A new crop of artists ponder nature

A landscape is associated with a lecturer's notes when mounted on lectern in Peter Fleps' 1986 work, *Law.*

stadt, with those enormous dream scenes of glorious mountains, and the more intimate Luminists—the new painters reject this seduction. "They don't want the illusion. They don't want to pretend you can really go back to that idyllic world. They're saying, 'How wonderful it is . . . and you can't have it because you're ruining it.' " That's why, Boettger adds, so much of the new work has an elegiac quality. "It's melancholic for the state of the world in general."

Joan Nelson is the one whose works show miles of sky. Her paintings often seem like something you barely noticed in the corner of a Renaissance Nativity scene or a Fragonard fête, and sometimes they are. "I used to do industrial scenes," she says, "but I started to get more interested in the land around the edges. I'll flip through a book for ideas but not actually refer to it. Or I might borrow specifically. From Bellini, for instance, the massive boulders and delicate foliage of *Saint Jerome Reading.*"

We are looking out from the mouth of a cave. All we see is a fringe of overhanging roots and plants along the top edge. The rest is sky. "I like the idea of the sky being ungraspable, unownable," she says, roaming through her cluttered apartment in the heart of Brooklyn. Art books lie on the floor. Thick blocks of nearly white Baltic birch are stacked up awaiting her brush: she works on six at a time because the layers of paint take so long to dry.

She is reading a book, *Witnesses to a Vanishing America,* that reinforces her anxiety about environmental problems. She used to join groups such as Greenpeace to try to contribute actively, "but now I feel that these issues are being confronted, so I concentrate on 'people' concerns. But I want to paint a thing before it's gone."

Scarring paintings for that Old Master effect

Yet simply to paint a beautiful scene is not enough: it's been done to death, as she and her peers are all too aware. So she makes sure her small paintings are seen for what they literally are: objects of wood. She covers the surfaces with wax or varnish, and then scars and gouges them for that Old Master effect. She leaves the edges of the boards basically unfinished and does not frame her work. "I want to create a very deep space and then negate it. I want to make a viewer think about what a painting really is."

Nelson's handsome fragments of landscape, her fragile willows, the graceful grasses, lovely details she seems to have rescued from the background of some too-familiar Da Vinci so she can help us rediscover them, have made her a popular success. Her works command as much as $26,000.

Now, we all know that conventional landscape

Neil Jenney's painting *Acid Story,* 1983-84, confronts an environmental threat by framing and labeling it.

Below, high-tech "armature" frames a slice of outdoors, as David Deutsch brings nature's setting up to date.

painting goes back a long way and is continuing in the hands of Andrew Wyeth and others. But this specific group of so-called new landscapes, with their poetic connections to the rising interest in the environment, perhaps can be traced to the mid-1970s, when Neil Jenney began producing massively framed pictures of ravaged forests, moving on to sky studies; and to the early '80s with the work of Sylvia Plimack Mangold (of the masking tape) and David Deutsch. Like Nelson, Deutsch started with paintings about technology and engineering, signs of the human intrusion into nature. By the mid-'80s he had shifted to pure landscape—trees, fields, imaginary forests, single oaks—set in sheets of aluminum or brass. He describes himself as a romantic but is careful not to sink into the picturesque.

The landscape, Deutsch says, is natural, as commonplace as plywood (which he loves, having covered his entire two-story West Village studio in it, floor to ceiling), and he is afraid that we consumers are going to waste this wonderful gift. On the other hand, it would be too easy, he says, to make a politically liberal statement on canvas bemoaning the loss, and he is not interested in leaving a mere record of the beauty that was. A photograph can do that, after all. He thinks of himself as an abstract artist who works with representative shapes like trees instead of Gene Davis stripes. The trees come from his mind, by the way, not from photographs and certainly not from direct observation. He loves the outdoors, but he is basically an urban person.

So many of these landscape painters live in cities—New York, Chicago, Los Angeles and points north. So many of them work from photographs or magazine ads or posters (Tracy Grayson's golf course series came from snapshots sent to him by his mother, a golfer). They see nature through images. They are distanced from it. And not surprisingly, some of them convey a vague fear of the outdoors, its strangeness and the fact that it may be doomed.

Green, 1988, by Tracy Grayson is from his series on golf courses, which he sees as artificial constructs.

Yvonne Jacquette is among the new landscapists who depict urban patterns; here, a Manhattan nocturne.

It is interesting that people almost never appear in their landscapes. There is no human presence, no little figures like those in the bottom foreground of the big Bierstadt panoramas. Some of their scenes could be of another planet. Or could appear to have been made from a hovering UFO—like Yvonne Jacquette's aerial views of nighttime Manhattan and San Diego, or the woods and fields of rural America.

Working from the passenger seat of a chartered plane, Jacquette records the abstract patterns she sees from above—those made by the moving headlights, lit windows and neon signs of the city at night, or by the variously tinted autumn foliage and roads of a New England forest. Her bold and colorful brushstrokes are reminiscent of the style of Reginald Marsh, an urban-scene painter of the 1930s. But while Marsh liked to get in close to bowery habitués and Coney Island bathers, Jacquette keeps her distance from the people in the streets. This gives her works, as one critic has written, a "paradoxical, obsessive but oddly emotionless" quality—a quality of many new landscape paintings.

The author, who is a frequent contributor to these pages, wrote about Sir Richard Burton in February 1989 and the Walters Art Gallery in August 1989.

As John Loughery wrote in *Arts Magazine* in 1987, commenting about an exhibit of new landscape art at the Whitney Museum's Stamford, Connecticut, branch: "The attitudes toward nature that inspired Cole and Inness, or even Dove and O'Keeffe, may no longer apply, but the role of nature in our lives, diminishing as it is, apparently occupies many a painter's and photographer's thoughts. . . . Many of the works . . . reflect on the precarious state of the landscape, the overtaking of the natural world by the technological, and the conversion of the landscape from a manifestation of the divine to an object of uneasy contemplation."

Look at the spooked landscapes of April Gornik. Look at *Equator* (opposite), with its two giant black fangs of rock jutting ominously from the water against a lowering evening sky. This was inspired by an actual event: Gornik and artist Eric Fischl were boating on Arizona's Lake Powell when a storm came up. They sped to safety by racing between two looming crags. "That lake experience was important for me," Gornik reported recently from her New York studio. "For the first time I saw literally sitting before me the complete image of what I had been trying to make up. I couldn't figure out why I was so moved by it, and even now my work reflects it: two things in front of you,

For ten years, twin rocks have been a recurring theme for April Gornik, who compares this painting, *Equator*, 1983, to a Zen rock garden.

twins, a portal. For me it's a mysteriously loaded sign."

Gornik emphasizes that her work is intended not to be merely ominous, but to show the ambiguity of nature and the great power of this indifferent force: "It's beautiful as well as scary." She has been painting for 12 years now, and her landscapes are not intended especially as a comment on the environment but as a poetic vehicle for her emotional and spiritual expression. "I'm very concerned about the environment," she adds, "but not through my landscapes. I work from dreams, things I read, photos taken on trips. I take an image over and make it mine until it becomes relatively abstract, like a Rorschach test."

Incidentally, both Gornik and David Deutsch mention Vermeer's great *View of Delft*, which hangs in The Hague. She calls it the finest landscape ever painted and says her work still is influenced by its architectural feeling and its astonishing light. This is the famous work about which Proust raves in *Remembrance of Things Past*, and of which Sir Kenneth Clark wrote, "the rendering of atmosphere reached a point of perfection that for sheer accuracy has never been surpassed. . . ." As for inspiration from American art, Gornik says she feels a close affinity with 19th-century Luminist painter Martin Johnson Heade.

The point here is that the new landscapists, for all their lyrical fantasies, stay in touch with the classics, as if reminding us that the endangered beauties of our planet are not just something dreamed up by calendar artists with Hasselblads, but have inspired people for thousands of years. One is tempted to say that much of this work is what one would expect from a generation so notoriously self-absorbed and ahistoric: deeply personal, distanced, often done on a small scale, like the postcards and snapshots they came from. We remind ourselves that these are city people, after all, who get their nature out of magazines. Forget about Monet sitting in front of his haystack from dawn to dusk, furiously splashing at a series of canvases right there in the field, raging to capture the light.

In that case, what do we do about Larry Gray? Until recently Gray lived in a redwood forest in Northern California. Although he has a master's degree from Yale, he has been described as "a real mountain man" and has spent a good bit of his time backpacking in the landscape that inspires him.

Ironically, Gray's scenes, featuring expansive skies, are imaginary. Often they depict Civil War destruction, greasy clouds roiling up from some ravaged Shenandoah village. "It's not about the Civil War," he

Sapelo Burning, 1988, "deals with history but is not a historical picture," says artist Larry Gray. Rather, this Civil War event, the burning of a Georgia island community, is far off on the horizon—as if seen across time.

says, caught in the midst of his move to Savannah, Georgia, to be nearer New York. "It's a statement about time. I see the past in the landscape, like the tracings of glaciers and the marks of humans. I'm fascinated with the signs that people and cultures have made on the land."

An active environmentalist, Gray belongs to the North Coast Environmental Center and other organizations, but does not like paintings to be seen as propaganda. "I'm wary of art that proselytizes. I want it just to report. My attitude is that if the human race self-destructs, something else will take our place . . . it might be some wonderful tree that takes over. The landscape will stay on."

At 45, Gray is somewhat older than most of the other new landscape artists, which may explain his atypical interest in history. More likely, it just shows what a varied group we have here. There are so many of them, pioneers from the '70s and newcomers who are not simply following the trend but are seeking their own, different truth. The nocturne appears again and again, as if to say the artists are so alienated from their outdoor environment that they prefer to see it at night, when it becomes something different, something abstract.

There is Mark Innerst, whose statement includes his giant frames—frames that enclose panoramic scenes depicted on a miniature scale. The effect is jarring, quite the opposite of the sublime effect once sought by Frederick Church, with his huge canvases, endless botanical detail and soft lighting. The viewer of an Innerst landscape is reminded that he is looking at an artifact in a museum, an experience that undermines the assumption that nature will always be here for us.

There is Chicago's Peter Fleps of the cinder block and lectern, and Los Angeles artist Don Suggs of the obscured Mount Shasta. There are the somber prime-val vistas of Michael Zwack and the cerebral works of "realist" Neil Jenney, who perhaps more than others has addressed specific environmental issues. Martha Alf does lovely, soft light studies in pastel pencil of pears and persimmons, for as critic Boettger says, "The very intensity of praise for fruit, a product of nature, suggests apprehension about its potential absence in the environment's gloomy future."

The smoky Ohio-scapes and moonlit harbors and deserts of Alfred Leslie prove that it's not entirely a young artist's game, for Leslie is 62. Roger Brown is one who populates his mordant pictures of suburbia and mountains. His cartoonish people inhabit high rises and tract houses overwhelmed by cataclysmic skies. And there is Robert Greene, who places his friends and dogs in fairy-tale gardens. And some veterans, such as Ed Ruscha, have joined the landscapers. And here are Nelsen Valentine's elusive tornado clouds, and Louisa Chase's mountains, and Dike Blair's luminism . . . impossible to list them all.

Their message—even from those who deny sending one—is quietly prophetic: it's a magnificent world out there, even if we do see it through the window. It has been celebrated in paint for thousands of years. And we're killing it. Sometimes, Joan Nelson says, she goes to upstate New York to paint from nature. "I'm always surprised it's still there," she mutters.

Mark Innerst's painting *Reserve*, with its massive frame, seems to turn landscape into a museum artifact.

Roger Brown tames the greater forces of nature into geometric patterns in *Approaching Storm*, 1980.

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By Jeanne McDermott

Some heartland farmers just say no to chemicals

The increasing pollution and decreasing effectiveness of agrichemicals spur a new interest in 'natural' farming practices

In the heart of North Dakota the sky opens so wide that you can almost see heaven. It dwarfs everything below, particularly a town with one store and a sturdy grain elevator rising out of shaggy-topped wheatfields. To describe Windsor as small does not do it justice. But if anyone could put it on the map, it's Fred Kirschenmann. "Oh, you mean the weed farmer!" says the store clerk. When Kirschenmann hears this he asks with a sly grin, "Are you sure that wasn't 'weird' farmer? We're infamous around here."

Dressed in jeans and an oil-stained sweatshirt, with a walkie-talkie clipped to his belt, Fred Kirschenmann looks like any other successful farmer as he drives a grain wagon out to feed his pastured cattle. Only his hat suggests that he belongs to a new breed. Instead of advertising a combine manufacturer or a seed company, it says "Farm Verified Organic." Fourteen years ago, when his father suffered a mild heart attack, Kirschenmann quit his job as dean of Curry College, in Massachusetts, to run the 3,100-acre farm where he had grown up. But there was a hitch. He would return only if he could farm organically. Theodore Kirschenmann told his crazy son that he would lose his shirt. But as the father watched the farm maintain and increase not only its crop yields but its income, skepticism gave way to pride. "We would never go back to chemicals," he says now, his son's staunchest supporter. "They ruin your soil."

Dick Thompson's 300-acre farm near Boone, Iowa, produces pigs, cattle, corn, soybeans, oats and hay.

It is a model of "sustainable" agriculture—crop rotation, cover crops and minimal use of chemicals.

Photographs by Richard Hamilton Smith

Ted Kirschenmann (right) farmed traditionally until his son Fred took over and went organic.

Medina, North Dakota, seems a bit far north for soybeans, but Fred Kirschenmann gets good results.

Increased yields are not always a result of cutting down on chemicals, and many studies show that in fact organic farms have lower yields. But even then, the Kirschenmanns avow, the lower costs of their methods leave the farmers, as well as the soil, better off.

The simple act of walking through Kirschenmann's fields of sunflowers confirms the difference. Unlike the cracked, hardened soil that is found on many large farms, his fields feel soft and spongy, crumbling into clods as black as coal and well aerated by earthworms. What Kirschenmann sees is that the soil structure, or tilth, is so loose that he uses less fuel to plow the fields than his father had to use when he farmed conventionally. "Organic farming does not simply mean farming without chemicals or fertilizers," explains Janet Kirschenmann, Fred's wife. "It means a commitment to the land." Or, to paraphrase the bumper sticker on the farm pickup, it means that they have stopped treating their soil like dirt.

Only a decade ago, the Kirschenmanns would have been dismissed as back-to-the-land crackpots or misguided zealots. But then, only a decade ago, nearly everyone celebrated the productivity of American agriculture without asking what toll it took on the environment and human health. To drive through the Iowa and Illinois Corn Belt at harvest time is to glimpse the overwhelming abundance of what has been called the richest farmland on Earth. For as far as the eye can see, crops ripen, covering the land like a plush brown carpet, encircling farm buildings, pushing against roadsides, washing over hills and valleys. But the monotony, the utter domestication of the landscape, hints at what has been sacrificed for this harvest of plenty. Forests have been shaved into mere windbreaks; marshes, swamps and wetlands filled like empty pockets; birds and wildflowers all but banished. Most disturbing are the transformations that escape the eye. In Iowa, soil erosion is so bad that half of the state's topsoil is found in the Mississippi delta. In at least 34 states the groundwater, once regarded as inviolable, shows signs of contamination by fertilizers and pesticides. And a recent study by the National Cancer Institute found that farmers who handle herbicides face a sixfold risk of getting cancer of the lymphatic system.

These problems have not gone unnoticed by the tillers of the soil. Today, American agriculture is poised

Jeanne McDermott is a Cambridge, Massachusetts, writer who specializes in science and technology. She last wrote on Muzak in the January 1990 issue.

He plants them experimentally in strips interspersed with sunflowers that act as a protective windbreak.

The use of a manure spreader on the farm assures that composted riches are returned to the soil.

on the edge of a revolution whose momentum astounds even its most ardent proponents. The group of farmers who are turning their backs on chemically intensive agriculture is so big and diverse that it has as many wings as a political party. At one end of the "alternative agriculture" spectrum are the organic growers, an estimated 1-2 percent of the nation's 2.2 million farmers, according to slightly varying legal definitions in 14 states. An eclectic but longstanding group, they are united by the belief that synthetic fertilizers and chemical pesticides aren't good for the health of anyone or anything. Naturally derived fertilizers and pesticides, however, are OK. Instead of using agrichemicals, for example, Kirschenmann fertilizes with cow manure, plants winter cover crops to plow into the soil in the spring as a "green" manure, and rotates his crops on three-, four- and five-year schedules to prevent pests from multiplying into crop-devastating numbers.

At the other end of the spectrum are the low-input advocates. Motivated by the need to save money, an estimated 30-40 percent of American farmers have taken simple steps to reduce their use of chemicals. One is Donn Klor, who grows corn and soybeans on his 600-acre farm in Buffalo, Illinois. He now uses half of the herbicides that he used five years ago, a feat accomplished largely when he stopped "spraying and praying," and switched to a method of cultivation known as ridge-tilling. Instead of planting his corn and soybeans on a flatly tilled field, he plants them in small ridges, and applies fertilizer and pesticide only to the ridges rather than over the entire field.

Between the two extremes is a fast-growing, harder-to-define group of farmers who care about saving the environment as well as money but are prepared to use agrichemicals in sparing amounts. Dick Thompson, who raises pigs, cattle, corn, soybeans, oats and hay on his 300-acre diversified farm in Boone, Iowa, practices what many would call "sustainable" agriculture (he prefers "sensible" or "practical"). Like organic farmers, Thompson relies on manure, cover crops and crop rotation, but unlike organic farmers, he spreads a little potassium fertilizer on his land and will resort to herbicide if all else fails.

At the heart of these new practices is the notion that farmers must work with nature as an ally. But since the end of World War II, according to Jack Doyle, author of *Altered Harvest*, a book about agricultural biotechnology, farmers have been taught to conquer nature. In the 1940s the idea of turning swords into

One winter cover crop protects another: here, tall oats shade low-growing nitrogen producers like vetch.

Donn Klor (left) of Buffalo, Illinois, describes his "new wave" farming techniques to agribusinessmen.

plowshares was taken quite literally. As the nation's leading munitions facility was being converted to the manufacture of synthetic fertilizers, agricultural researchers were also shifting their attention from crop rotation, and the use of manures and cover crops—practices now being embraced, ironically, as alternatives—and becoming experts in chemical warfare against pests and weeds. Farms became food factories—the bigger the better. Within a generation, the United States succeeded in feeding the world.

But the quick success of big agriculture overshadowed the fact that the conquest of nature is ultimately a losing battle. "I had a devastating experience with the indiscriminate use of pesticides," explains Bob Bergland, the farmer who served as President Jimmy Carter's Secretary of Agriculture. In the mid-'50s, insects destroyed the clover crop on his family farm in northern Minnesota. "I called an extension agent and he ordered an application of DDT by airplane, which I did. The next day, nothing was living. No bees, no birds. I said, 'This is unnatural.' Then, the insects migrated back in. The extension agent said, 'Spray again.' The third time the insects came back, I didn't spray. When I started to question the authorities, they said, 'This is all we know.' "

That experience was one reason why, in 1977, Bergland established a division within the U.S. Department of Agriculture to study how organic farmers managed to survive without chemicals. "I came under heavy attack from the chemical companies. They never wanted those questions asked," says Bergland. "They

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were afraid that something useful might come out of it." When John Block took over as President Ronald Reagan's Secretary of Agriculture in 1981, he declared organic farming a "dead end." And it might have remained so if everything had been sunshine and fresh air down on the farm. But by the end of the decade, the invisible deterioration of the rural environment had become impossible for farmers to ignore. In 1945, farmers lost 3.5 percent of their corn crop to insects. In 1988, with pesticide use increased a thousandfold, farmers lost 12 percent. And by that time, many serious agricultural pests had become resistant to one or more pesticides.

Consumers were also becoming concerned about the use of chemicals on the farm. When a report last year by the Natural Resources Defense Council made Alar a household word, urban dwellers, too, began to wonder if modern agriculture was a hazard to their health. While critics dubbed the NRDC as "nutritional terrorists," the demand for organic produce skyrocketed overnight.

It seems unlikely that more than a small minority of American farmers will go completely organic. It is too hard to do in the absence of livestock, nutrient-rich soil or cool climates—and pesticide-free foods can be grown with other methods. But those who do farm organically deserve recognition as pioneers. It would be hard to find a better example of today's organic farmer than Fred Kirschenmann, a strapping man with hands like baseball mitts and a quick laugh. In mid-September, with only his sallow-faced sunflowers left to harvest, he is catching up on machinery repair. And what a job it is. He's got six tractors, two combines, a loader, manure spreader, swather, rock picker, chisel plow, blade plow, rotary hoe, rod weeder and lots more. While cranking a recalcitrant bolt off a flat tire on the manure spreader, he laughs at the idea—often voiced by representatives of the agrichemical industry—that organic farming means turning the clock back. His grandfather, who once farmed several miles away, didn't have this fleet of modern technology, but more important, he lacked his grandson's mindset. "My grandfather was a miner of the soil. He broke up a piece of sod, farmed it for six years and then moved on to the next. He spread manure on the nearest field to get rid of it. Nobody thought of soil as a resource."

Kirschenmann farms organically because he wants to be a good steward of the land. "If we manage the land accurately," he says, "we have what amounts to zero soil erosion." Indeed, in a comparison of an organic farm with a conventional farm, John Reganold, professor of agronomy at Washington State University in Pullman, found that the erosion rate on the organic farm was slow enough that the topsoil regenerated itself. But the benefits to the soil go beyond simply keeping it in place. "When I go talking to conventional farmers, the first question they ask is how many four-wheel-drive tractors do I have. My answer is none," says Kirschenmann. So rich is the soil in decayed organic matter that the tilth is less compact than soil on conventional farms. Consequently, Kirschenmann does not need to employ the power of a four-wheel-drive, and that in turn means that he avoids further compaction. And soil rich in organic matter also holds

On Dick Thompson's farm, in this experimental plot of ridge-tilled corn the use of both fertilizers and pesticides is confined to the ridges. This can reduce the amount of chemicals applied to crops by as much as half. Weeds between rows are chopped mechanically.

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On Kirschenmann's farm, cover crops are plowed under as "green" manure to enrich the soil.

the moisture better, a necessity in the arid Northern plains, and a natural shield against the drought of the past two years.

But Kirschenmann's success depends on more than just good dirt. It depends on crop diversity rather than endless monocultures. His operation is the picture image of the classic farmstead, with a hundred yearling steers pastured on the ridge past the pond, and small fields that checkerboard the rolling prairie—no one field seems to be planted in the same crop as any other. "Our insurance is built into our diversity," he says. "The real economic advantage comes in the way our risks are spread out." He gets a premium for selling his wheat, rye, oats, flax, soybeans, sunflowers, millet and buckwheat under the organic label. "If the premium disappeared, we would not change," he explains, echoing a sentiment repeated by many organic farmers. "The vast majority of farmers go to the bank in the spring and borrow $30,000 to $50,000 for herbicides, insecticides and fertilizers," he says. Kirschenmann has two major expenses each year: hybrid seeds and the energy to run his equipment. In the past nine years, he hasn't borrowed any money to run the farm. And that's the way he likes it.

Later, when Kirschenmann tests the moisture content of the minimountain of millet drying in the barn, he recalls that the local agricultural extension office didn't even have a pamphlet on organic farming when he first started. "I had a friend, an organic farmer, who said, 'I don't know what will work for you, but make sure you use crop rotation.' " That was about as much advice as he got. Crop rotation is the easiest—though not the quickest—way to create the diversity needed to disrupt pest cycles and boost soil moisture and fertility. Kirschenmann didn't fully appreciate that it takes three years to establish an organic farm, in part because it takes that long to establish a good rotation. His first year, he says, "was an ideal growing season: the spring was warm, we had residual fertility in the soil. I said, 'This is a piece of cake.' The next years were the opposite—disasters. Everyone thought we were going down the tubes. Then, when the fourth and fifth years were good, farmers started to ask what varieties we were planting. They didn't want to believe it was the organic methods. Now, more recently, they say, 'Wish we could do it.' "

Relying on herbicides that didn't work

It is a big leap for a conventional farmer to become organic. Aware that calamity is never far away, farmers tend to be wary of change. According to Dan Frieberg of the Iowa Fertilizer and Chemical Dealer's Association, most farmers look to fertilizer and agrichemical dealers for expertise. But farmers with severely compacted soil or polluted wells are finding that their local authorities do not have all the answers.

Donn Klor discovered the hard way that he had overused agrichemicals. In 1983, he and his wife, Susan, then the hired hand, logged 80- to 90-hour weeks, relying on herbicides that didn't seem to work, running the tractor on soil so compacted that rain puddled on top as if the field were a concrete parking lot. Reluctantly, they talked about taking jobs in nearby Springfield, the state capital, and farming in the evenings. Then one day, the person they had hired to apply herbicide missed a field. "Come to find that the field with no herbicides didn't have any weed problems," says Klor.

The Klors' farm lies in the prosperous flats of central Illinois, where the land runs away from the eye, teasing you at the horizon to catch up. Here, farmers talk as knowledgeably about the Chicago Commodity Exchange as about the latest model of combine. The Klors' farm, although smaller, looks pretty much like

BOLLA

Il vino classico d'Italia

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Once home to a farm family, this abandoned house now casts a lonely shadow on a Wisconsin field, a reminder of the decline of small farms throughout the nation.

everyone else's. Donn Klor sits inside his combine's quiet cabin, high above the neat rows of spindly soybeans, and points out the difference: his crops grow not on a flat field but on small ridges. The secret of the ridges is that they allow Klor to target his fertilizers and pesticides where they count—the seed bed, not the rows in between. Thanks to ridge-tilling and to killing weed seedlings in spring with a rotary hoe, his costs for weed control dropped from $30 an acre to $15. As a result of constant testing of his soil—he has gone from "paying no attention to watching the soil test closely to doing a tissue analysis"—his fertilizer costs have dropped too, but not as drastically.

"It's so easy to eliminate 50 percent of the cost," says Klor, one of a small group of Illinois farmers to do so. He wants to cut still more. To his great surprise, he looks to the organic farmers for money-saving ideas. He is experimenting with cover crops. He plants alfalfa, peas, clover, vetch and rye in the fall to hold the soil over the winter and to add nitrogen (and in the case of rye, to inhibit weeds) when plowed under in the spring. But he hasn't found the right crop yet. He wants to rotate more crops, but it means losing some of his government subsidy (the rules favor keeping acreage in the same crop over an extended period). When he was growing up, his family kept livestock, but he doesn't have the money now to start a herd: "We're stuck with cropping until we can work our way back into cattle." However, the Klors can afford to wait. "The only reason that we are still farming is because we switched," explains Susan. "If we had all the expenses of conventional farming, we would not be farming today. We look at sustainable agriculture as a way to reduce input prices and get more profit. I can say that the environment is not the reason we did it."

The small changes made by the Klors look radical to the agrichemical industry. Last year it sold $10 billion worth of fertilizers and $4 billion worth of pesticides to American farmers; it does not welcome losing even a little of what has become big business. In California alone, the industry seeks to raise $16 million to combat a referendum that would ban many pesticides and fertilizers. "The way we practice agriculture is not going to be revolutionized," declares John McCarthy, vice president of scientific and regulatory affairs at the National Agricultural Chemical Association in Washington, D.C.

While chemical lobbyists cast doubts on the revolution, it is clear that farmers are looking increasingly to the land-grant universities for more information on alternative methods. "Until the universities come out and say that this is the way to farm, I think we'll go through a period of turmoil," says Klor. According to a poll by Iowa State University, 76 percent of the state's farmers believe that modern agriculture relies too heavily on chemicals, and 56 percent would adopt low-input methods if more information were available. But farmers lack information because researchers at land-grant universities focus on projects that will get funded by agrichemical companies. "One of the saddest things to me is that the whole land-grant system is diluted by commercial interests," says Klor. "Sustainable agriculture lacks an industry. It doesn't have the bucks to back it."

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Dick Thompson checks his "sensibly grown" corn. He's used herbicides once in the past 21 years.

A hotly contested symbol of the alternative agriculture movement's success is the Department of Agriculture's Low Input Sustainable Agriculture program (LISA). Started in the 1980s, it is a product of a coalition of environmentalists and agriculturists. It funds 78 research projects, ranging from an economic comparison of strawberry growers who use pesticides with those who kill pests by covering the soil with plastic, to the development of a corn rootworm insecticide that uses only a small percentage of the toxin now required. LISA's budget is $4.5 million for 1989-90, which makes it, in the words of one Washington insider, "budget dust." Yet, such a pittance so angered the agrichemical industry that some of its representatives have spread the myth that LISA will lead to world starvation. "Farmers go to coffeeshops and all they hear is that LISA will cut your yield," says Klor. In fact, some studies show a small increase.

A more ambitious and no less controversial effort is under way in Iowa. In 1987, two Iowa state legislators, David Osterberg and Paul Johnson, sponsored a bill that taxed the sale of agrichemicals to create and fund the Leopold Center for Sustainable Agriculture at Iowa State University in Ames. "The agrichemical industry was outraged," explains Osterberg. "The day the bill passed, the Iowa Fertilizer and Chemical Dealer's Association had 300 of its 1,500 members outside the House asking us not to vote for it." Pesticide manufacturers threatened to pull their products. The industry targeted the legislators for defeat. Three years later, Osterberg remains in office, farmers can still buy their pesticides and according to Tufts University agriculture specialist William Lockeretz, "Iowa is the best example of cooperation and collaboration between experts at the university and grass-roots farmers." The bridge between the two is Dick Thompson.

"We stack the deck against the weeds"

Thompson's farm is as meticulously organized and as carefully run as a scientific laboratory, which in some ways it is. Located ten miles from Iowa State, with cattle grazing by the roadside, its neatly lettered sign reads "Thompson's On-Farm Research." Last year, Thompson's farm attracted more than 800 visitors from around the world. As he gives a tour, Thompson stops at two side-by-side plots, one marked "Ridge-Till with Herbicides" and the other, "Ridge-Till without Herbicides." He gets out of the pickup and stoops his tall frame as he bushwhacks into the cornfield. Underneath the ripe plants it is dark, but not too dark to see the surprising result: weeds bedevil the row with herbicides and have disappeared from the row without. Herbicides encourage weed growth by wreaking havoc with the natural pecking order that different species establish. Rather than destroy the pecking order, Thompson takes advantage of it, explaining that "we stack the deck against the weeds." For example, he plants crops densely to crowd weeds out and cultivates varieties that stunt the weeds with shade.

A soft-voiced man with an air of cautious but unswerving determination, Thompson is like a NASA scientist in the way he makes and coordinates thousands of small, interlocking decisions, such as when to plant, how deep to set the plow and how many seeds to sow. He grew up on this farm, getting his bachelor's and master's degrees from Iowa State in the 1950s. "I was taught specialization and expansion," he says with a wry smile. "That held for about ten years." Thompson quit agrichemicals in 1968 because he "was highly leveraged. The pigs were sick. The cattle were sick. Things weren't working and we felt like we were in a corner." He happened to go to a meeting on "natural" farming, as organic is sometimes called, and a light bulb switched on. After that, he fertilized his fields with hog manure (he now uses sewage sludge, too),

resumed the five-year rotation—corn, soybeans, corn, oats, hay—that his father had once used, and switched to ridge-tilling his corn and soybeans.

A believer, Thompson began to spread the word. "In years back, the first thing I used to say was that I don't use chemicals. Right away, we lost 95 percent of our audience." It slowly dawned on him that this all-or-nothing attitude was not only off-putting but impractical. In fact, he found that as the years passed, he needed to add a little synthetic fertilizer to keep up with his neighbor's corn yields. And in a tight spot, he was grateful for herbicide. (Although he's quick to add that it has been "once in 21 years. Not a bad ratio.") Thompson made decisions about how and when to intervene chemically by the seat of his pants, but that didn't satisfy his desire to see other farmers wean themselves as far from chemicals as they could. In 1985, he organized the Practical Farmers of Iowa, a group of 26 farmers who carry out field trials, carefully randomized and replicated to satisfy the statisticians, that compare conventional, low-input and chemical-free techniques. No longer does Thompson offer testimonials. He gives proof.

But Thompson remains as much a student as a teacher. In his hog house, for example, he feeds one group of pigs on corn from the elevator, another on corn farmed with inorganic fertilizers and yet a third on corn farmed with manure. When dysentery hit not long ago, he noticed that the hogs that ate manure-fertilized corn fared better. Likewise, when spider mites attacked his soybeans for the first time in 20 years, he noticed that insects destroyed only the plants grown in potassium-deficient soil. Do hogs raised on manure-fertilized corn resist disease better? Do insects attack nutritionally deficient plants? A decade ago, farmers might have said "Who cares?" But not anymore.

"The 1990s are the beginning of the end of the chemical era," says Dave Dyer, executive director of American Farmland Trust. "Agrichemicals will shift from being the driving force to being the helping hand." The vision of such a future—one in which farmers cease to be among the nation's leading polluters of streams and groundwater, consumers no longer worry about eating an apple a day, the topsoil regenerates itself and the richest farmland on Earth becomes even richer—is too compelling to ignore.

Occupants of the Thompson farm's hog house may not realize it, but they're part guinea pig, too. In feeding experiments, those on manure-fertilized corn appeared to resist dysentery, a common ailment.

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A cyclist takes a breather along the Burke-Gilman Trail to survey Seattle's skyline across Lake Union; 800 commuters a day pedal to work on the 12-mile-long route, which turns into a playground on weekends.

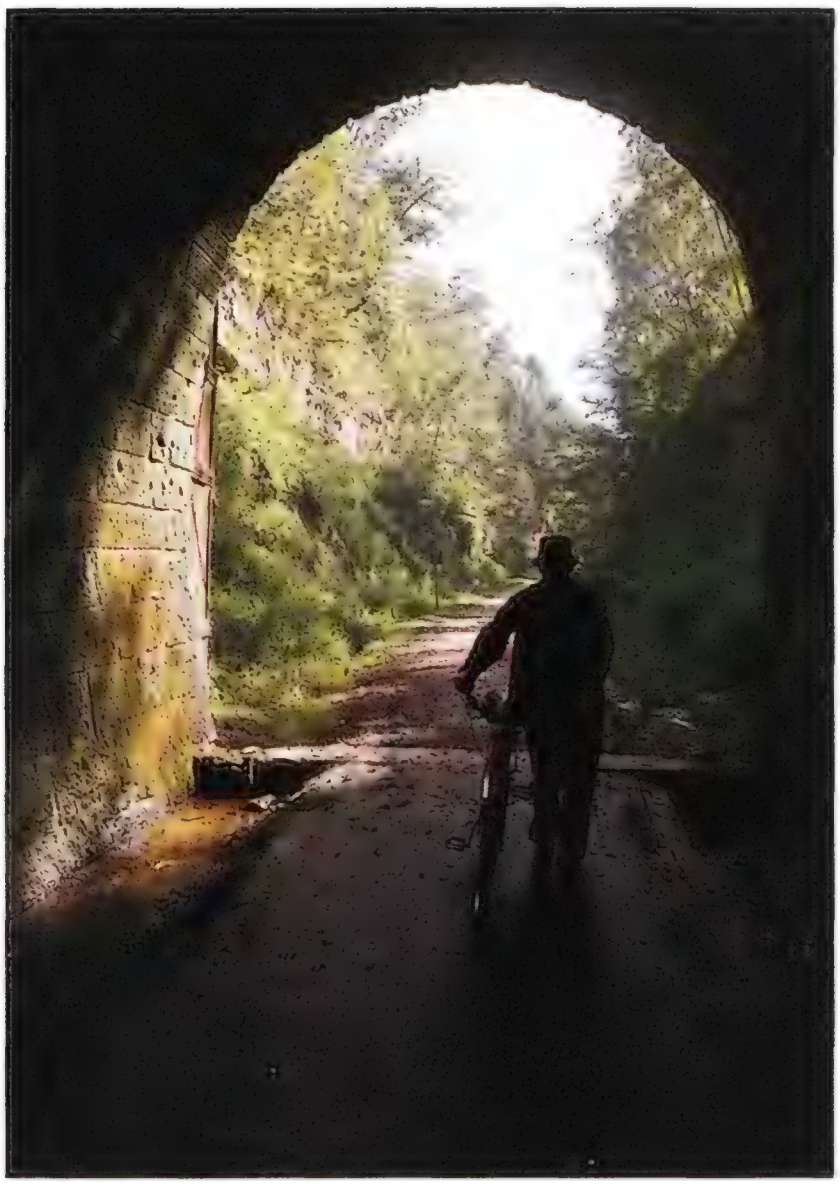
By Judy Mills

Clearing the path for all of us where trains once ran

Talk about a good idea: with 150,000 miles of abandoned rail corridors and a whole lot of people who love to be outdoors, why not?

My paternal grandfather died when I was 6 years old. I recall only a tall, wiry man named John who wore blue-and-white-striped overalls and a tall billed cap to match. The gold pocketwatch he received after half a century as an engineer for the Northern Pacific Railroad lay for years in the corner of my upper dresser drawer. Its original owner remained a snapshot in my mind, one-dimensional and faded.

Last summer, nearly 30 years after his death, I finally found something to share with this stranger called Grandpa. A rented mountain bike was my iron horse; my legs served as its pistons. I chugged along what had been part of a main railroad line in his time, but is, in mine, a 32-mile-long trail between the towns of Elroy and Sparta in southwestern Wisconsin. I could almost hear the whistle blow and smell the burning coal. I strained against the 3-percent grade, a slow-moving engine on the uphill climb, and then delighted in the respite of coasting downhill. Entering a long tunnel, I turned on my flashlight, just as my grand-



Old-timer Erwin Graewin walks his bike through an 1873 tunnel on the Elroy-Sparta Trail in Wisconsin.

father might have beamed his locomotive's headlight, and pedaled in the chill dampness toward a pinhole of light at the other end.

As I biked through rolling fields and small towns that day, past red barns, gleaming silos and green fields dotted with black-and-white cows, I saw our country the way John Mills had seen it—from the backyard. It was an intimate, reassuringly homey view of the heartland, with its clotheslines and vegetable gardens, toolsheds and woodpiles, back stoops and corncribs. It seemed to suggest that all was well in this particular slice of rural America, and for a former child of the suburbs, who vacationed every summer in Los Angeles, exploring it was more fun than a trip to Disneyland.

While it doesn't attract Disney-size crowds, the Elroy-Sparta State Trail is not exactly a well-kept secret. More than 55,000 bikers and assorted other outdoor types get their kicks on it each year. They come from every state in the Union and as far away as South Africa and Norway. To those who are in a position to know about such things, moreover, the Wisconsin pathway is a national landmark. Established nearly a quarter of a century ago, it was among the first of its kind—a forerunner of the booming recreational trend called rails-to-trails.

As its name suggests, this phenomenon has to do with the conversion of abandoned railroad rights-of-way into public trails. Although the idea has been around awhile, it's only within the past several years that it has picked up a real head of steam. By now, portions of more than 240 rail lines all across the country have been transformed into trails, and another 250 are in the works. The majority of the 30 million or so Americans who get out on these trails annually are cyclists. The rest? They're hikers, joggers, walkers, bird-watchers, cross-country skiers, horseback riders—you name it.

Helping local groups get trails started

As you consider all the hoopla over the upcoming anniversary of Earth Day, think about this: it's fine to worry about protecting the land, but it's also important to acknowledge the growing public pressure for recreational access to it. That's what rails-to-trails is all about, according to David Burwell, president of the Rails-to-Trails Conservancy. Established as a nonprofit group in 1985, the organization already has more than 62,000 members. It helps local affiliates get trails started, lobbies in Washington, D.C., and publishes a newsletter, manuals and guidebooks. "This program is enabling more and more people to enjoy the countryside by using trails that already exist," Burwell says, "and that means relatively little is required in the way of development."

The concept behind rails-to-trails may turn out, in the 1990s, to be the biggest idea to come down the recreational pike since Frederick Law Olmsted advocated urban parks. The trouble with parks is, there aren't enough of them. At a time when nearly everyone's notion of fun seems to be doing something active outdoors, often in a more or less straight line, we're rapidly running out of land. In the old days—which is to say, 50 years ago—the "country" was only a short walk or ride from where many of us lived. Today, as you've probably noticed, that's no longer the case.

Unlike hunters and motorboaters, most of us don't require much open space in which to recreate. We'll settle for a narrow old path somewhere. Ergo, a new thing: the *linear* park. It's nothing more than a slender ribbon of land, shielded from the real world by a buffer of greenery, that cuts across private and public jurisdictions alike. And it doesn't take up much room—200 acres of railroad or utility right-of-way can create a "park" more than 20 miles long—but a lot of people can do a lot of things on it.

The best-known older example of this is the Appa-

Photographs by Phil Schofield

Trails where trains once ran

An enterprising entrepreneur on the Burke-Gilman tailors his marketing scheme to thirsty clientele.

lachian Trail, which was championed by conservationist Benton MacKaye in the 1920s, pieced together in the '30s and now runs nearly the entire length of the Eastern Seaboard. In the 1970s a group called the National Trails Council made a big push to get hikers and other "path people" organized. Congress had already passed the National Trails Act, establishing a system of historic and scenic trails. By the time a Presidential outdoors commission endorsed it in 1987, the idea of connecting urban and rural areas with multipurpose greenbelts had taken firm root.

Today linearity is very big indeed. Conservationists and wildlife managers are talking about using "corridors" to link up refuges and other fragments of habitat. Urban planners are advocating "greenways"—trails along streams and rivers and other strips of natural beauty—as instruments of community renewal. Many states have hired trail coordinators to oversee the acquisition of development rights and work with local groups. A national trails task force is trying to keep track of everything that's going on.

The most visible manifestation of all this is the rails-to-trails network, which at present consists of more than 3,000 miles of trails in 34 states. The main concentrations are in the Northeast and the Midwest. Wisconsin is the mileage leader, with nearly 466; California and Washington State have the most trails, with 22 each. The shortest trail, about a quarter of a mile, is in Tulsa, Oklahoma; the longest, 145 miles, is in Washington State.

The variety is spectacular. Take the Boca Grande Bike Path, for example, which runs the six-mile length of a barrier island off the Florida coast. It follows a route once used by trains hauling phosphate from the mainland to ships docked at the island's south port. Or, take the Mount Lowe Railroad Trail. It winds up a mountain outside Los Angeles, along what was once called "the railway in the clouds." Then there's the 45-mile-long Illinois Prairie Path in Cook, Kane and DuPage counties, which preserves rare remnants of authentic prairie landscape along the old Chicago, Aurora and Elgin Railroad corridor.

Conversion makes sense—but it's not easy

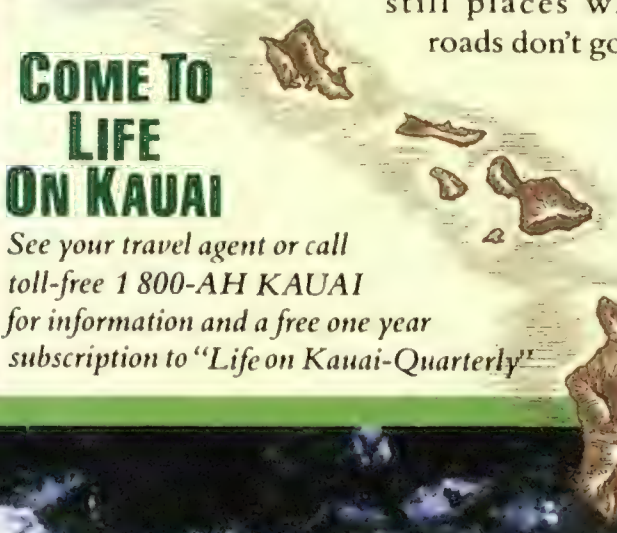
The beauty of these and other trails is that they've already been built. At the peak of the railroading era, from 1900 to 1930, nearly 300,000 miles of corridors crisscrossed the country. More than half have been abandoned, and another 3,000 miles are pulled from service every year. Although converting these rights-of-way into trails makes a lot of sense, it's not easy. The typical project crosses private lands, roads, utilities and easements. And there's another problem. Landowners often fight rail conversions for reasons having mainly

LIFE ON KAUAI

Along the Na Pali coast, there is an 11-mile hike called the Kalalau Trail. When considering this challenge, there are two things to remember: the path is never flat and the scenery is never dull.

The road to Kauai's north end stops completely at the entrance to the Kalalau trail. In ancient times only royalty was allowed access to this part of the island.

Today anyone can enjoy the breathtaking views on the trail, pick guava from the trees or rest on secluded north shore beaches. And while climbing over rocks, up towering hills and through streams isn't easy, it's worth it. After all, people come to life on Kauai because there are still places where roads don't go.



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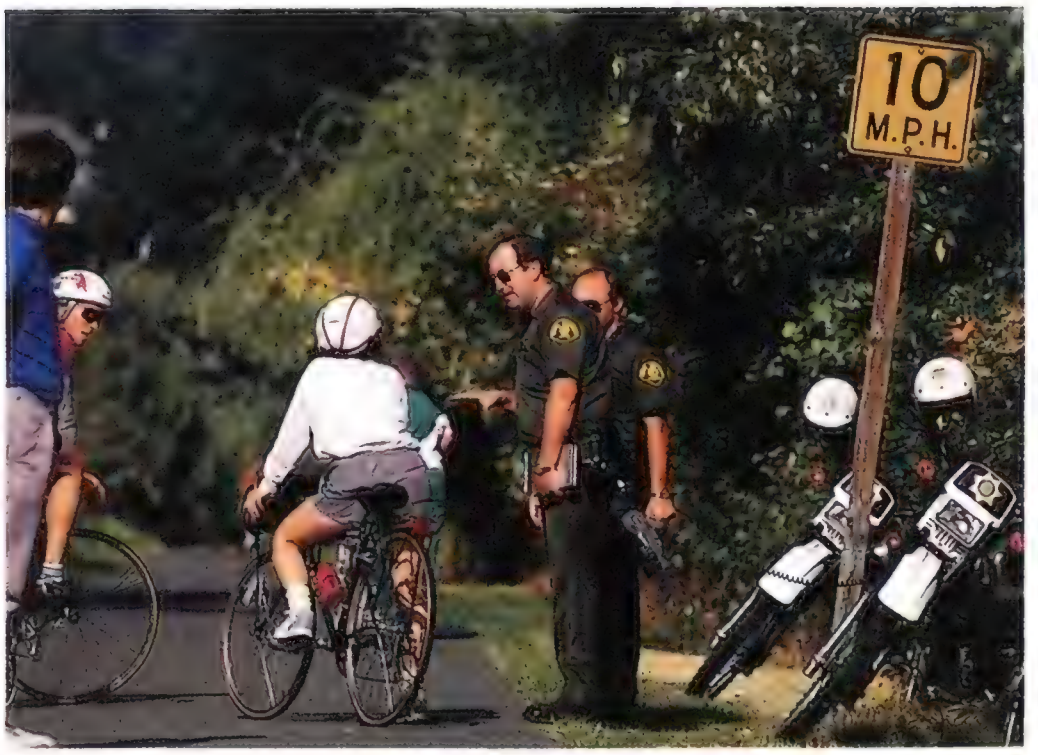
Prof. Bill Moritz has lost ten pounds commuting under his own power.



Smokey bags a chagrined Seattle speeder with help from a radar gun; luckily, she gets off with just a warning this time.

to do with privacy and security, and it can get sticky.

Consider the case of the Missouri River State Trail, or Katy Trail, which supporters hope will eventually link the town of St. Charles in the eastern part of the state with Sedalia some 200 miles to the west. When it was originally proposed in 1986, this project sparked a controversy that's now referred to as the Katy Wars. Protesters erected dozens of fences along the right-of-way; mounds of dirt were bulldozed as barriers. Railroad ties were stolen and bridges were burned. Today the proposed trail is still in limbo, except for a six-mile stretch that runs through a public wildlife refuge. A recent U.S. Supreme Court decision is expected to resolve the dispute between landowners and the State of Missouri, which may clear the way for the trail.

Conversions are usually undertaken by local citizens' groups or park authorities, few of which are prepared for the political and legal tangles they run into. Then there's the matter of coming up with the cash to buy and develop a trail. When a railroad notifies the Interstate Commerce Commission (ICC) that it intends to abandon a certain right-of-way, a citizens' group usually has ten days to give notice that it wants the land for a trail. At that point, the carrier states its asking price, which can run well into the millions. If the local folks can't raise the money right away, the railroad may find other buyers, and once that happens it's nearly impossible to put a deal back together again. Trail advocates on Washington State's Olympic Peninsula, for instance, are currently trying to buy a 51-mile stretch of right-of-way that is in the hands of as many as 400 different owners.

Or take the 11-mile-long strip of CSX Corporation tracks that comprises the proposed Capital Crescent Trail running from downtown Washington, D.C. to Silver Spring, Maryland, a conversion effort that began in 1986. The proposed trail would hook up with others in the greater Washington area, creating what some describe loosely as a "bicycle beltway." Great idea, but who's going to pay for it?

Chris Brown works for the National Park Service by day and for the Coalition for the Capital Crescent Trail the rest of the time. "Our basic tactic," he told me recently, "has been to go out and seize the trail." Advocates marked the abandoned tracks with stickers, like a hiking trail. They led bird-watching and wildflower expeditions there, and planted trees. During their first "trail" cleanup, the railroad kicked them off for trespassing. Eventually, the National Park Service and Montgomery County, Maryland, agreed to back a plan for a trail. In December 1988, the county bought its 6.4-mile segment of the trail for $10 million. Congress has appropriated $4 million for part of the District segment and has been asked to put up another $7 million to buy the rest.

Selling the idea of a rail-trail sometimes calls for unconventional methods. Whatever works, Stan Bales will tell you. He's a recreation planner for the Bureau of Land Management in California. Not long ago, he and a few cohorts took his state director, Ed Hastey, on

The author, executive editor of Washington *magazine in Seattle, specializes in articles on adventure travel and endangered species.*

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Pittsburgh 1945

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Pittsburgh today

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Camping on the Elroy-Sparta, Ned Zuelsdorff and Paul Morrison study maps for their 400-mile tour.

a hike along the proposed route of the 30-mile-long Bizz Johnson Trail, which at one point passes through an 800-foot-long tunnel. Bales wanted to make the experience come alive for Hastey—something he accomplished with the use of a tape recorder and a very strong speaker. On the day of the hike, the group carried no flashlights. When they got to the midpoint of the tunnel, a loud whistle sounded and the *choo-choo-choo-CHOO* of an old steam locomotive shook the timbers—and the state director. "I didn't run," Hastey recalls. "But I did look to see if it was really coming."

Sometimes the excitement on a trail is not so contrived. Last year there was a ruckus on the Bizz Johnson that resulted in its being dubbed the "Bizz Grizz" by the local paper in Susanville. Not that the animal encountered by high school teacher Suzanne Shaw was actually a grizzly, but it was a very large bear nonetheless. She stood, stunned, on the trail as it nonchalantly ambled down to the river. Then, although she was alone at the time, she yelled out, "It's a bear!" before beating a retreat.

The rails-to-trails story is really a tale of two trails—one urban, one rural. Seattle's Burke-Gilman Trail, one of the most heavily used in the nation, embodies the urban. It is paved and has traffic signals and signs. Cops use radar guns to nab speeding cyclists. On its 12.1-mile route from the heart of the city into the wooded suburbs, the Burke-Gilman snakes through the University of Washington campus, skirts the shores of Lake Washington, then wends its way past a public-housing project and some of Seattle's most opulent homes. On a sunny evening last summer, I jogged past race walkers, blackberry pickers, a family of Canada geese, and a cyclist pulling a trailer loaded with camping gear and his golden retriever. Birdsong in the trail's green canopy mixed with the muffled growl of cars accelerating 50 feet and a world away.

A former mayor of Seattle once called the Burke-Gilman an "interstate" for bicyclists. It certainly seemed to fit that description for Bill Moritz recently on the first day of a new quarter at the University of Washington. The digital speedometer on his 18-speed Schwinn clocked him just above the 15-mile-per-hour limit as we pedaled along the 15-mile stretch between his home and his office. A 46-year-old professor of electrical engineering, Moritz started commuting by bike when he realized he could beat both cars and buses during Seattle's rush hour. Since then, he's lost ten pounds and dropped his resting heart rate to 50. Joining him are some 800 other weekday bike commuters, including a federal judge who works at bankruptcy court downtown. Nearly 80 percent of this trail's one million annual users are cyclists. The other 20 percent are pedestrians.

The Burke-Gilman has been a catalyst for what you might call a renaissance of trail building throughout the Puget Sound area. Soon it will link up with a 17-mile trail to the east and a 6-mile segment that heads west to the shores of the sound. Sometime this decade, 140 miles of trails are expected to connect

Cows heading in from pasture and chauffeur-driven toddlers are common sights on the Wisconsin trail.

downtown Seattle with suburbs to the north, south and east of the city, as well as with bike routes accessed by ferries to the west.

Seattle has a history of trailblazing. Back in 1896, bicyclists there financed and built an elaborate network of paths. Their nemesis then was not the car but the cow. In 1901, the Queen City Good Roads Club hired an attorney to prosecute the owners of wandering cattle. That same summer, warnings were issued about bears on the Lake Washington trail.

A single forested boulevard is all that remains of the old system, but the Burke-Gilman is still linked to that time. It runs along the corridor formerly occupied by the tracks of the Seattle, Lake Shore and Eastern Railroad, which were laid down in 1885 by Judge Thomas Burke, his friend Daniel Gilman and a handful of investors. The line served Puget Sound logging interests for decades. In 1971, the last owner, Burlington Northern Railroad Company, filed a request with the ICC to abandon it.

Converting the rail to a trail was "an idea that came out of the neighborhoods," Peter Lagerwey told me. He's the bicycle-program coordinator for the city of Seattle. The first "hike-in" along the route took place on an early-fall day in 1971. Proponents picked up litter along the way to show property owners that trail users make good neighbors. They were greeted by hand-painted backyard signs saying, "Hike in the woods, not in my yard," "Welcome Hell's Angels" and "We don't want the trail."

Two years later, Seattle acquired the right-of-way through a complex deal of purchases and property exchanges with Burlington Northern. The trail was paved and finally opened in the summer of 1978. Today it's used as a selling point for adjacent real estate. A recent study shows that the trail enhances property values but does not bring about an increase in crime. Not long ago, when Burlington Northern sold a Montana developer part of a proposed extension for the Burke-Gilman, the entire city rose up in arms. "Every community has something it considers sacred," reflects Peter Lagerwey. "You don't sell Mount Rainier, the Washington Monument, the Statue of Liberty—or the Burke-Gilman Trail." The Montana businessman eventually gave the land to the city, the railroad agreed to cooperate with rail-trail conversions throughout the city, and the people voted in favor of a $117 million open-space bond issue, with nearly $33 million earmarked for trails.

If Burke-Gilman is an urban freeway, then Elroy-Sparta is its opposite—a rural road. The lush, undulating farmland it passes through is a beguiling terrain that reminded me of the rolling countryside in southern France. Where the trail occasionally crosses a county highway it's not unusual to meet up with an Amish family clip-clopping to town in a horse-drawn buggy. But the trail's biggest attractions are its tunnels, the longest of which, Tunnel No. 3, goes the better part of a mile. After three years of blasting, digging and hauling, it opened in 1873. Massive iron-trimmed

"Bikin' Boyd" Wallace, Elroy-Sparta's unofficial trail boss, hangs out at a restored watchman's shack.

doors, used to keep out snow and ice, hang at either end.

Coming out of Tunnel No. 3, I met up with "Bikin' Boyd" Wallace on his sturdy John Deere ten-speed. After issuing a friendly greeting, the spry old-timer informed me that he pedals nearly every day to this spot—which was once the village of Summit—from the town of Norwalk, three miles down the trail. Summit was a community of watchmen who opened and closed the tunnel doors in the winter, along with a few other railroaders and a postman. It's now an "interpretive" site, a historical and educational display where you can learn about the history of railroading in the area and talk to Boyd (above), a onetime gas station owner and postal clerk who, having lived in Norwalk for most of his 81 years, is something of an expert on the subject. "I rode the trains, sure," he told me.

It's hard to believe now, but in the early 1900s the traffic on that part of the main line of the Chicago and North Western Railway was almost nonstop. A half-dozen passenger trains and 40 to 50 freight trains rumbled through every day—one every 15 or 20 minutes. Boyd remembers them, especially the passenger trains—one going each way, morning, noon and midnight. He hasn't forgotten that "the Midnight," as they used to refer to the late train, actually came through Norwalk at 12:20 A.M. "In my courtship days," he told me, "the whistle was curfew. That was it."

Passenger service was eliminated in 1963, and freight trains stopped running one year later. Boyd has had a bike since 1948, so he welcomed a trail instead of the tracks. "Some people in Norwalk thought there'd be a bunch of outlaws coming through on bicycles, but it ain't that way at all. People who've got enough ambition to ride a bike, they're Grade A in the first place."

They also have money to spend. Most of the people who use the trail are white-collar professionals. Each year they dole out more than $1 million on everything from bicycle repairs and soft drinks dispensed at backyard pop machines to Friday-night fish fries (a tradition in Wisconsin) and lodging. Myself, I stayed with farm families who open their homes to bikers in order to make a few extra dollars. The going rate: $40 to $60 a night for a double, which includes more breakfast than a lumberjack could eat.

Many trail users from out of town camp overnight at a small park in Wilton. Maybe once a summer a ferocious Midwestern thunderstorm rolls through at about midnight, flooding the area out. When that happens, Nalani Bever, whose house overlooks the campsite, drives down in her van and ferries any waterlogged souls she can find up to the school gym, where they bed down for the rest of the night. On other hot summer nights, Bever has been awakened through the years by the wafting notes of "On Top of Old Smoky," as the locals serenaded the campers. "The Welch boys here in Wilton are kind of notorious for that," she laughs. "That's one of their favorite songs. Every time I heard it, I knew they were in the group."

In some ways my bike trip through the Badger State's dairyland took on the character of a pilgrimage. For the first time, I saw harvest queens with that fresh-faced Midwestern look riding on the backs of spit-and-polish convertibles in village parades. I mingled with the spectators at county-fair talent contests where hardly anyone onstage could carry a tune. I could have camped in parks along the way and picked apples at local orchards. I could have gone fishing in the pretty lake outside of Norwalk or bird-watching in the marshland of the Baraboo River bottom. Unfortunately, I couldn't do everything; I had to keep moving. But by the time I finished my journey, I had discovered an America I never knew before.

When I got back home, my dad invited me over to see some movies of Grandpa's retirement party and some others of a redheaded toddler, me, crawling around on his engineer's overalls. Unfortunately, we couldn't find a projector old enough to accommodate the film, and so I never did see those movies. But no matter, I've heard the train whistles blow across time now, and I know what it's like to see the light at the end of the tunnel.

School's out! Two boys from Kendall Elementary make a beeline home along the Elroy-Sparta Trail.

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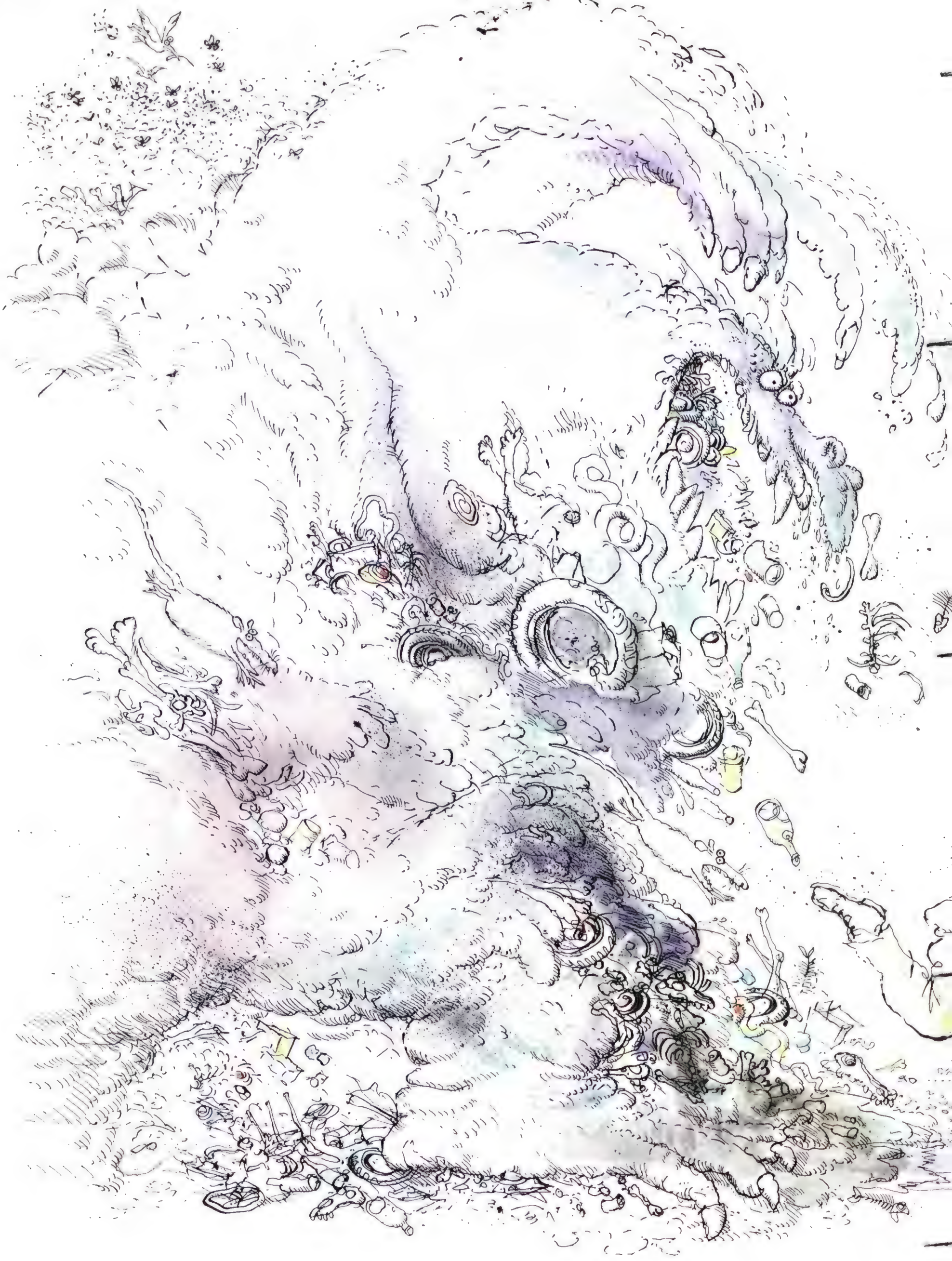


By Richard Wolkomir

'I learned that it just keeps getting deeper'

To study garbage disposal, our reporter takes matter into his own hands and works for a week at his local landfill

"Did I ever tell you about the naked woman?" Gary Villa asked me one day. He was the office clerk, a tall, skinny guy with a riverboat gambler's black mustache who kept a box of dog biscuits handy for the spaniels and beagles riding shotgun beside some of his customers. He sat at his window like Charon on the river Styx, levying fees on all who would venture across.

"She drove up in a Ford van wearing raggedy jeans and a flannel shirt," Gary said. "She only had a couple trash bags in the back, so I said 'Four bucks' and waved her past." Commercial rubbish trucks he sends roaring up the road to the trash mountain's peak, where the gigantic yellow compactor grinds down each day's deposits. But he directed the woman to a bin located just beyond the office for the convenience of householders. Idly, he watched her toss in her two plastic bags.

"Then she took off her clothes and threw them into the box, too," Gary said.

Naked, the woman nonchalantly walked back to the

"We need to look at our waste as a great economic and environmental opportunity."

Illustrations by Ronald Searle

front of the van. She reached inside, pulled out a summer frock and slipped it on. Then she got in and drove away. "Beats me," said Gary a bit wistfully.

I was spending a week working at a privately owned landfill near my house in Montpelier, Vermont. It was lunchtime in the office, and as we swatted bluebottle flies, I listened to the six regular employees trade landfill stories. One of the first things I learned was that if you start talking trash, you never know where you'll end up. For instance, Pete Gregoire, the man who was in charge at the Central Vermont Landfill, likes to tell how he took a call one morning from a local police chief. It seemed one of his police officers had inadvertently thrown away some camping gear that was being held as evidence. Sleeping bags. A tent. It was important, the chief said, to retrieve those things.

"When did they get thrown out?" Pete asked.

"About five months ago," the police chief said.

Pete, a grizzled Vietnam veteran, looked out the window at the mountain he oversees. Jungle patrols had left him mellow. "Come on over and shovel away," he told the chief amiably. "It'll be in there someplace—about 20 feet down."

That was the second thing about trash and garbage: I learned that it just keeps getting deeper. We had an alp of garbage, anything and everything, from broken eggshells to crushed soup cans, dead radios, half-eaten T-bone steaks in a state of decline, yesterday's newspapers and last year's telephone books. For a week I watched truck after truck roar up that mountain of waste, unload, then roar down for more. As the days went by, I found it hard to empathize with Jim Hightower, Texas Commissioner of Agriculture, who wrote, "We need to look at our waste as a great economic and environmental opportunity."

Surprisingly, our modern "dump," which is what landfills used to be called, doesn't smell as bad as you might think; there are still plenty of gulls but surprisingly few rats. I am talking, though, about what is known as a "sanitary" landfill. Every night we covered it with earth, like tucking in a baby, except that we used a bulldozer. Gulls and rats can't get a prolonged whiff of all the good stuff buried under that thick, airless blanket of soil.

Montpelier's landfill is Vermont's largest in terms of people served (60,000 in 21 towns) and in volume of trash handled (615 tons per week). But it's a pip-squeak compared with the Fresh Kills landfill on Staten Island, which ingests 22,000 tons per *day*. The planet's biggest dump, Fresh Kills is like a geological upthrust. Within a decade or so, it is expected to peak at 505 feet. Then New York will cap it, close it, finish planting it and most likely call it a park.

Add together all the landfills in this country and you find that we throw away about 160 million tons a year. That makes us the per-capita champions of waste in the world. According to the Environmental Protection Agency, each American generates a pound more trash per day than each citizen of prosperous West Germany. Some experts claim we're steadily widening our lead. By the year 2000, the EPA predicts, we'll be up to 190 million tons, and that does not include things like sludge, construction debris, factory wastes and junked cars. The big question is: Where will it all go? So far, the answer seems to be: Nowhere.

Remember the *Mobro?* Three years ago, that ill-fated scow left Islip, Long Island, carrying some 3,000 tons of garbage and sailed into symbolhood. The barge was looking for a place to get rid of its cargo. North Carolina turned it away. So did five other states, including Florida and Louisiana, as well as Belize, the Bahamas and Mexico. After 57 forlorn days on the high seas, the *Mobro* returned to New York, still bearing its by-now-infamous load. Three and a half months later, the trash was burned and finally buried back home in Islip.

Look out for toxic leakers

Currently the United States recycles 10 percent of its trash, incinerates 10 percent and sends 80 percent to landfills. But as a nation we face *Mobro*ization. Over the next few years perhaps a third of our remaining landfills will close, many because they are full and some because they're toxic leakers. Parts of the Northeast already truck much of their trash to landfills in places like western Pennsylvania, Ohio, Kentucky, Michigan and West Virginia. An employee of the Central Vermont Landfill drives an empty tractor-trailer to pick up a load at a "transfer station" on the state's western edge, where towns have no landfills. He makes two or three 120-mile round trips a day, hauling 40,000 pounds of garbage each time.

As for that national 10-percent-recycling statistic, Vermont and the rest of the country still have a long way to go. Japan, for example, recycles about three times more solid waste than we do. Meanwhile, as the garbage continues to pile up, from Main Street to Wall Street it's becoming the talk of the town. Even up here in my rustic environs, rubbish hits the headlines nearly every day. More than a dozen bills aimed at limiting waste have lately been combined into one all-purpose piece of legislation, which will be voted on by lawmakers in Vermont this spring. And nationally, a new

Richard Wolkomir, a frequent contributor, has gently spoofed all sorts of subjects in the pages of SMITHSONIAN. *Celebrated British cartoonist Ronald Searle has been mourning the folly of the world with laughter since the end of World War II.*

"I have even heard of some trash sites where the dump workers rescue, and lay out as a kind of trophy display, all sorts of objets d'art that have been abandoned by waste-driven householders."

Days and nights at a local landfill

environmental journal called *Garbage* began publication last year, printed, of course, on recycled paper. At DeKorte Park in Lyndhurst, New Jersey, to amuse and instruct the populace, officials have opened what must be the nation's first trash museum, featuring a simulated landfill made with real rubbish. I have even heard of some trash sites where the dump workers rescue and lay out, as a kind of trophy display, all sorts of objets d'art that have been abandoned by waste-driven householders.

All that set me thinking. And so, full of morbid curiosity, I arranged to ride with my own local debris to its eternal resting-place and then stick around for a while to study waste management firsthand. In preparation, my wife, Joyce, and I carefully logged all of our throwaways for a week, from "cardboard package new flashlight came in" to "wilted parsley" and "pork chop bones."

The list had a dismal fascination. It laid bare pathetic gestures toward a healthy diet ("bits of fat cut from corned beef"). It showed backsliding ("pizza box"). We stood revealed as packaging addicts: "2 chicken potpie boxes," "frozen spinach wrapping," "7 yogurt containers," "package for new can opener," "butterscotch pudding box." In all, 56 packages. Some castoffs were ecologically neutral ("pencil shavings," "dryer lint," "14 pieces of dental floss," "floor sweepings"), but we clearly were living an arborcidal life, bagging 32 newspapers, 24 paper napkins, 5 catalogs, junk mail, To Do lists, as well as myriad defunct supermarket coupons.

Altogether the two of us produced 42 pounds: 29 pounds of paper and cardboard, 13 pounds of everything else. This placed us each a bit below the national per-capita yearly average of 1,274 pounds of normal household refuse.

When the Dix Rubbish Removal truck stopped at our house, I climbed aboard with Conrad Dix, cowboy-lean, with a Prince Valiant haircut and a wry sense of humor. At one farm he winched up a dumpster, spilling rotted hay, cans, banana peels and a woman's fancy boot into the truck's open maw. From the dumpster's bottom a reeking green fluid splashed into the truck. "I make a mean cream-of-dumpster soup," Conrad said.

At an invalid's house, he went through the rooms collecting wastebaskets and bags. After he left that stop one day, Conrad's mother called him on the truck radio to say the invalid, who lives alone, had telephoned her. He had been using a plastic trash bag to stash his laundry, and Conrad had collected it by mistake. "We brought it back," Conrad said.

Such Lake Wobegon atmospherics are fading. Our local radio station has long since dropped its Saturday morning "Music to Go to the Dump By" program, in part because the landfills are no longer open on weekends. Throughout Vermont, as elsewhere in the United States, free dumping is generally history. At my landfill, it now costs $2 a big bag, $1 a small bag, with price hikes promised. That trend has led to solid-waste rebellions all over the state.

The most common form of rebellion in rural areas is back-roads dumping. Conrad showed me one seemingly pristine mountain glen. On closer inspection, I found heaped among the ferns beside the road everything from stoves, tires, tin siding and coiled hoses to a truck body, barbecue grills and an old broom. "There's this great American misconception that garbage has to be pitched over a bank," Conrad said.

"Out of sight, out of mind"

We can be pretty piggy nowadays, but things used to be a lot worse. In the late 1800s, the city's street-cleaning commissioner reported that New York's garbage "defiled the beaches in an intolerable degree." In cities everywhere, people and their horses dumped on streets. Trash sometimes accumulated into chest-high piles of slops, cinders, pots, boots and manure. Rain turned it to slime. Dry, it was dusty. As Rudyard Kipling said of Chicago: "I desire urgently never to see it again. Its air is dirt."

When I was growing up in the 1950s, the attitude was "out of sight, out of mind." Our New York village had a toss-for-free dump in a marshy cove along the Hudson River. That peninsula of trash was presided over by a bearded hermit who lived in a makeshift shack. I shot bottles there with my .22 rifle, while ducks quacked and the Hudson rose and fell with the tides. Meanwhile, the dump quietly oozed unspeakable juices into the water.

That era is gone. To get to the Central Vermont

"One state-of-the-art landfill has a closed circuit television security system, and an on-site restaurant."

Landfill, you turn off the highway onto a broad macadam drive, past flower beds, landscaped lawns and pines. It looks like the entrance to a state park. The landfill itself is a miniature Mount Fuji, covered with grass and topped by "snow" that's actually the day's deposits of garbage.

Mountain building was our work. The trucks charged up and dumped at the peak. The compactor, which looks like an enormous bulldozer, spread the trash, then flattened it under its spiked wheels. Each evening, we scooped earth from an adjacent pit and covered the naked peak. As a result, the landfill was a wedding cake with alternating layers of garbage and dirt. When sections of the landfill reached their preordained height, workers sealed them under clay and topsoil and seeded them with grass.

Money lies among the melon rinds

My initial chore was helping to build a wire-mesh fence to snag the endlessly blowing papers. As I worked, I listened, for landfills accumulate tales and melodramas. "This guy baked a diamond engagement ring into a cake to surprise his girlfriend," Gary Villa said one noon, swatting a fly to heaven. When the beaming romanticist served his cake, the ring failed to appear. Still, he liked his idea, chipped incisors be darned, and so he left the cake with his girlfriend and awaited her delighted call. She ate a few more slices. No ring. By then the cake was stale, and so she threw it out. "They were up here poking around for it," Gary said, "and went away looking pretty dismal."

Stamp and coin collections have gone into the landfill, too, along with the antique candlestick one couple used inside their Halloween pumpkin. And money lies among the melon rinds and chicken skins, for stores sometimes accidentally toss out their day's receipts. One doughnut franchise manager, worried about employee pilfering, hid $1,500 in a trash bag. A zealous cleaning boy threw the bag into a dumpster. The next morning, the manager was up on the pile of trash, digging with a shovel until he found his cash.

I always assumed that trash left in a landfill eventually molders into soil, but I discovered this is not the case; most things remain virtually mummified. The dirt covering, and the landfill's bulk, tend to keep out rain and air. As a result, oxygen-loving bacteria play only a limited role in transforming ordinary household trash into earth. Other bacteria do digest biodegradable material, such as food scraps, but this process takes a long time and may stop altogether under dry conditions. In effect, a landfill is often like a pyramid where trash lies embalmed.

Archaeologist William Rathje of the University of Arizona, who conducts landfill digs, has turned up still-readable newspapers dumped back in 1952. At Fresh Kills recently, his team unearthed a hunk of ham fat thrown away five years earlier, and still as plump and supple as if it had been trimmed from yesterday's dinner.

Once these hills of garbage are capped, closed and seeded, communities often give them a name, like "Mount Trashmore," and declare them parks. Yet under the grass and trees, evil juices trickle. "Let's check the leachate," Pete Gregoire said to me one day. As we drove down the hill to the pump house, Pete explained that a certain amount of rain percolates down through the landfill, carrying metals and chemicals from the garbage, creating a poisonous brew called leachate. "Don't get it on your hands—it burns," Pete said.

Semi-impermeable clay under the landfill and a collection pipe, as well as a subterranean trench around the site, trap most of the leachate. Pumps send it back to the top of the landfill, a process that filters out some chemicals while adding others. Pete monitors instruments to make sure leachate is not leaking into the groundwater.

At the pump house, he lowered a container down a pipe to retrieve groundwater for testing. His instruments showed that its electrical conductivity was low, indicating it was leachate-free. Then he lowered a cup down another pipe and drew up a mugful of leachate. It was tawny and smelled like a wicked blend of vinegar, sweaty socks and dead animals. Its electrical conductivity was high; it registered near the top of the scale. "If the pump has problems, an automated dialer calls several key people, starting with me," Pete said.

Everybody cries: "Not in my backyard!"

One day, I took time off from my "job" to visit the Cornell Waste Management Institute in Ithaca, New York. There, scientist Daryl Ditz told me: "Philosophically, a landfill is only a temporary solution—you're digging a hole and filling it up." He said new landfills rest in a nonleaking basin of clay and synthetic liners like a huge bathtub. One state-of-the-art landfill in Taylor, Pennsylvania, has a leachate collection system, a closed circuit television security system, a truck wash and an on-site restaurant that is supposed to keep garbage-truck drivers from parking on streets at lunchtime. But finding places to put even such modern dumps is tough. Everybody (including me) cries: "Not in my backyard!"

Garbage woes are hard to cure in a society that annually tosses out 240 million tires, 1.6 billion pens, 2 billion razors and blades, and 16 billion diapers. Daryl estimates that we could recycle at least 30 percent of our trash flow. But even that may not be enough.

One frequently used, but highly controversial, alternative is burning trash to boil water, creating steam

"A reeking green fluid splashed into the truck.
'I make a mean cream-of-dumpster soup,' Conrad said."

for generating electricity. The United States now has more than a hundred such waste-to-energy plants in operation, most of them hooked up to produce electrical power. The number is likely to increase dramatically in ten years, but what once seemed to be a fine technological solution has met with serious opposition. "When you burn trash, you're left with 20 to 30 percent of the volume of compacted waste you started with, and that buys time at the landfills," Daryl said. "The danger is that what's left is ash that contains the toxic residues of such things as car and household batteries. It doesn't help, either, that the emissions from the plants introduce harmful dioxins, acid gases and heavy metals into our air."

Experts agree that easing the nation's garbage glut will require a blend of cures: a change in our myopic, convenience-oriented, buy-and-dispose-of mentality; less waste built in at the factory (packaging now constitutes about a third of all our garbage); more recycling; cleaner trash incineration plants; and more and better landfills. "As a society, we don't seem able to decide how to decide on these issues," Dick Schuler told me. He's the director of the Cornell Waste Management Institute, and he suspects that we'll only start paying attention when trash removal begins costing the average household $1,000 a year. In many parts of the country, that time may not be far off.

Still, when I returned to the Central Vermont Landfill, it didn't seem like Armageddon. It was more like *Our Town*. "How you doing, Soup?" Gary asked a white-haired man in a new station wagon full of potted petunias. "Well enough to be up and around and taking nourishment," Soup said. Later, a man in a pickup truck pulled up and leaned against Gary's window. "Don't ask me how I'm doing," he said. "Lord, I'm 58 years old and I've lost my sex life and everything."

We had to turn away some visitors. "I'm selling our farm and I've got a half-gallon of creosote and old bags of arsenic of lead I used for dusting potatoes," a man in an old truck told Pete.

"I can't take it," Pete said. "Call the state." He gave the farmer the number.

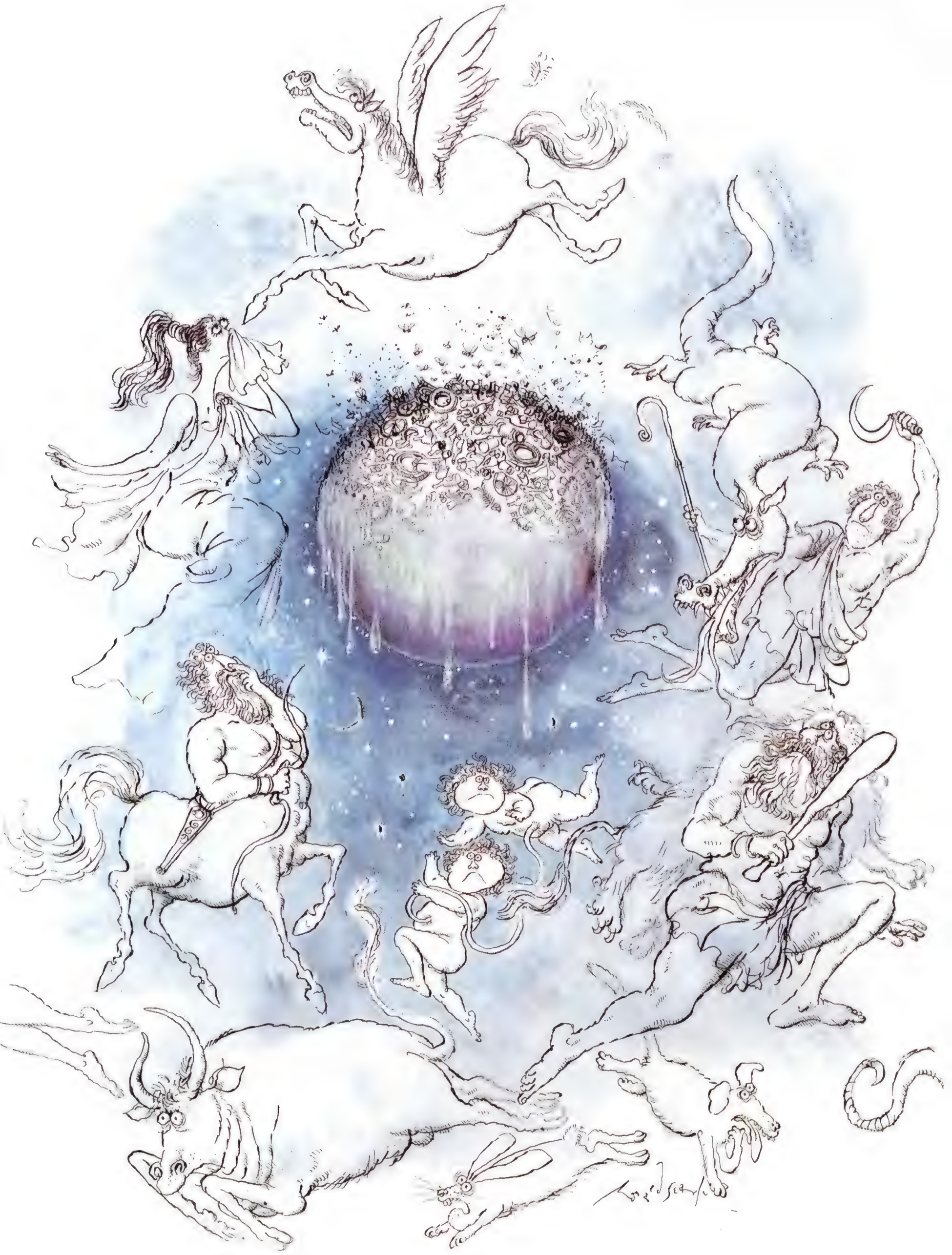
In the caste system of garbage, toxic wastes are the untouchables. One day our landfill hosted a seminar put on by the state recycling association. Behind the office about 30 of us watched a truck-mounted cherry picker extend its steel claw toward a cliff of washing machines, dryers, stoves—the household appliances referred to in the disposal business as "white goods." From a refrigerator's innards it plucked a melon-size black globe, the compressor, releasing a white gas that geysered out and evanesced into the sky. "Freon," somebody said. There were murmurs of "ozone hole."

Seminar leader Carey Lewis-Hurlburt, a Connecticut environmental official, said there is no cost-efficient way to remove Freon from junked appliances. She warned that the gas becomes an acid that can burn skin and eyes. "Move away from any appliance that hisses," she said. Then she attacked an air conditioner with a pair of pliers, demonstrating how to remove a capacitor as delicately as a surgeon might extract a gallbladder. She explained that capacitors housed in sealed metal cases usually contain oil. If they were made before 1978, when regulations governing PCBs (polychlorinated biphenyls) started going into effect, the oil probably contains these pollutants. Ingesting PCBs, she said, can lead to "disorders of the kidneys, digestive system and reproductive organs, so use rubber gloves to handle leaking capacitors and wear goggles."

Work at a landfill has its highs, too, like the afternoon Shannon Whipple, the regular driver, let me drive the compactor. I had watched him maneuver his awesome equipment like a mahout deftly steering an elephant. Now I sat in the driver's seat, while he crouched on the outside platform. The 300-horsepower engine growled when I stepped on the gas. Then I lowered the blade and began spreading trash.

I watched out for wire, which can wrap around an axle like a snake. I also avoided pieces of pipe lying among the orange peels and popped soccer balls; bent pipes, clipped by the wheels, can whiz through the cab's windows like missiles. I was living a boy's fantasy —mastering a big machine and squashing things— until Shannon spoke up. "Well, some people can just take off and master it in five minutes and others never do get the hang of it," he said, adding graciously, "but they can probably do other things."

"You find that we throw away about 160 million tons a year. . . . The big question is: Where will it all go?"



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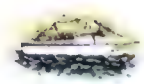

also named us the world's **MOST COURTEOUS** travel company. *Fielding's* said

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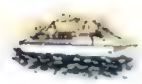

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By Jon Krakauer

If you want to fight air pollution, go plant a tree

Acting on the conviction that this is sound advice, arborphiles all across the country are picking up their shovels and doing just that

Volunteer digs a deep hole for a Canary Island pine sapling on Martin Luther King Boulevard, Los Angeles.

20

Ambling down a trail in the Santa Monica Mountains, Andy Lipkis crests a brushy ridge and pauses to take in the view. The sun is high and warm in the November sky. A stand of eucalyptus trees perfumes the air. Overhead, a hawk floats lazily on a thermal. It's another golden day in paradise—except for the miasma of smog that blankets the Los Angeles basin below, transforming Hollywood, Burbank and the San Fernando Valley into a brownish-yellow blur. "That," Lipkis says, "is what got me started planting trees."

As the founder of a nonprofit corporation called TreePeople, Lipkis is in the vanguard of a burgeoning campaign to cure what ails America's cities by filling them up with greeneries. Bearded, yet still boyish-looking at 35, he's often referred to as a modern-day Johnny Appleseed (he calls himself a "citizen-forester"), but the fact is that Mr. Lipkis' accomplishments exceed Mr. Appleseed's by far. During the past decade, he has overseen the planting of some 2 million trees in Los Angeles alone. By one count, TreePeople's efforts have resulted in the planting of more than 200 million trees around the world.

Lipkis is the most visible figure to emerge thus far from the new urban-forestry movement. He's been profiled in *Time* magazine, has bantered with Johnny Carson on the *Tonight Show* and transplants saplings at media events in the company of rock stars and Hollywood legends. But Lipkis has plenty of company these days because enthusiasm for city trees is busting out all over. Botanists at the University of Wisconsin and at the National Arboretum, in Washington, D.C., have developed hardy cultivars specifically adapted to handle the rigors of urban life. Research by the U.S. Forest Service, the Lawrence Berkeley Laboratory and the University of Arizona suggests that planting the right trees in the right places can improve city life in ways never before suspected. Inspired by the recent scientific findings, community-based associations such

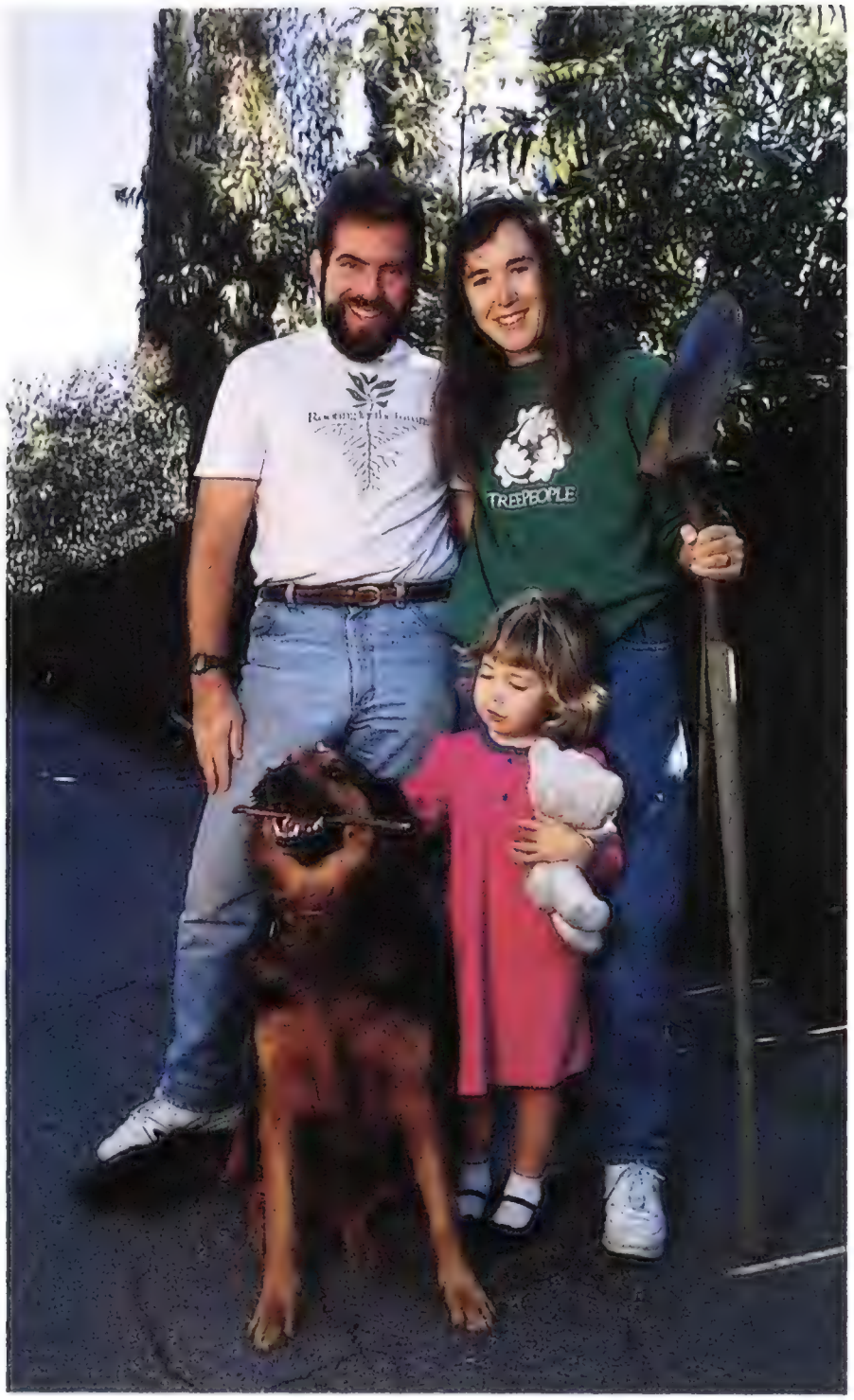
Thousands of people turned out early this year for a "tree-planting day" that spruced up a seven-mile stretch of thoroughfare. Bad air is a big problem in the Los Angeles basin, and trees may be part of the solution.

as Trees Atlanta, the NYC Street Tree Consortium, Philadelphia Green, Trees for Houston, Chicago's Neighborwoods, and Friends of the Urban Forest in San Francisco have initiated ambitious volunteer planting and maintenance programs.

The action is not limited to the urban scene. Maryland has launched an initiative called Green Shores that aims to reduce agricultural and chemical runoff into the Chesapeake Bay by planting trees beside rivers throughout the state. The American Forestry Association (AFA) is promoting Global ReLeaf, a campaign to plant 100 million trees nationwide by 1992, in part to offset global warming. In his State of the Union address this year, President George Bush proposed planting a billion trees annually for the next ten years. If that many trees survived to maturity, they would significantly reduce air pollution.

Tree planting campaigns are not new, of course. Way back in 1872, a farsighted farmer named J. Sterling Morton convinced the state of Nebraska to cele-

How trees can help save our cities



Andy Lipkis, at home with wife, Katie, and daughter, Phoebe (and Jack), is main force behind TreePeople.

brate April 10 of that year as Arbor Day. The main purpose of this annual tree-planting holiday, which is now observed internationally on the last Friday in April, is educational. Minneapolis attorney Donald Willeke, a spokesman for urban forestry and Global ReLeaf, says: "It's about time we recognized that trees aren't mere niceties. They're necessities."

All of this attention to trees has materialized none too soon, for America's forests are in trouble. In much of Colorado the slopes of the Rocky Mountains are an unsightly brown patchwork of beetle-killed pines. The gypsy moth—imported into the United States circa 1869 by a misguided French entymologist to produce silk—has defoliated millions of acres of trees in more than 20 states. Acid rain and other pollutants are falling on the forests of New England; in California, drought-stressed eucalyptuses are succumbing to a parasite newly arrived from Australia. Insidious plagues are infecting dogwoods, sycamores, fir trees and sugar maples up and down the Eastern Seaboard.

The trees that grow in our cities, not surprisingly, are having an especially rough time of it. Tail-pipe soot and noxious, smog-borne gases clog the pores of their leaves. Skyscrapers blot out more and more of the sun. Roots are hemmed in by pavement, and legions of poodles and schnauzers pay their respects with lifted legs. (A few years ago, a functionary at one New York conservation group estimated that street trees in the city were being watered with 22,000 gallons of poisonous dog urine every day.) Maimings at the hands of errant drivers and even of vandals are on the rise. Last year an arborcidal nut case in Texas attempted to do in Austin's 500-year-old Treaty Oak by pouring a potent herbicide over its roots.

Don't take trees for granted

In all but a handful of cities—Milwaukee and Minneapolis being notable exceptions—the decline of the tree has been exacerbated by shrinking budgets and mushrooming crises. "It's not easy to argue that money should go for trees instead of schools, or low-income housing, or the war on drugs," says William Lough, New York City's chief forester. Researcher Rowan Rowntree, an urban-forest specialist with the Forest Service, sadly allows that "the problem with city trees is that we take them for granted. We tend to notice them only when they're gone."

Which may help explain why we've been noticing them lately. The AFA surveyed the condition of street trees in 20 cities between 1975 and 1985, and found that on average, just one tree was being planted for every four that had died. In many cities, eight times as many trees were dying as were being planted. The average life span of a tree in New York City: seven years.

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A supervisor (left) trained by TreePeople helps tie up a newly planted pine during King Boulevard event.

In a residential area, woman digs hole wide enough to accept barrier that forces roots to grow straight down.

Workers tend a newly planted tree. It will need to be watered for two years before roots are established.

The saddest story of all, of course, is the demise of the grand old American elm. European settlers found the woods here thick with elms, many of them towering more than a hundred feet above the forest floor. Enamored of the tree's lush canopy and baronial profile, they wasted no time lining their roads and town squares with fast-growing elm seedlings. By and by, towering elms arched cathedral-like over backyards and boulevards throughout the heartland. The glories of *Ulmus americana* were sung by the Republic's poets, and that admiration was reflected in the large number of towns with names like Elmdale, Elmwood, Elmhurst, Elm Lake and Elm Grove.

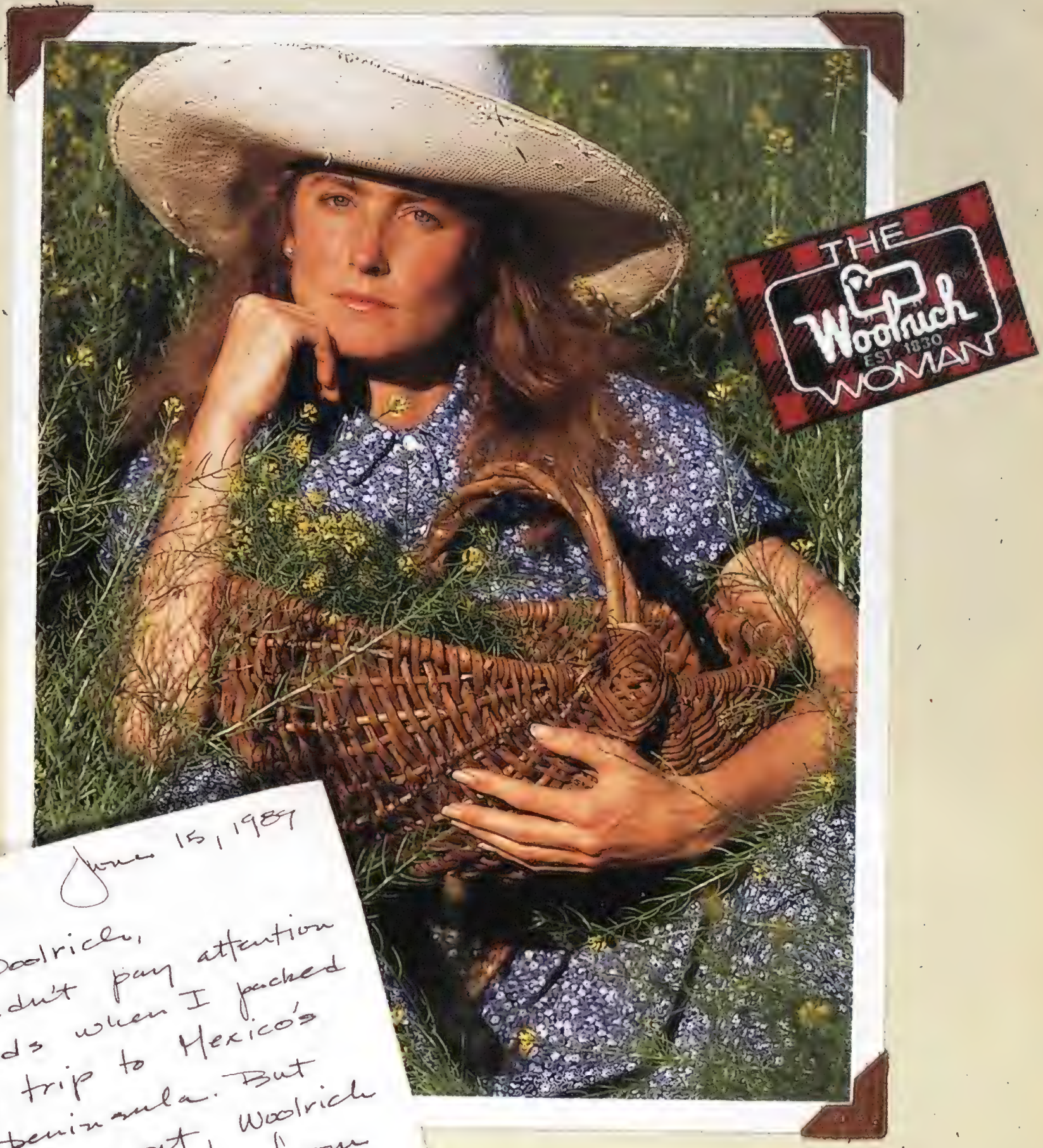
Then, in the early 1930s, a shipment of logs from Europe showed up in Ohio tainted with the fungus *Ceratocystis ulmi*, better known as Dutch elm disease. It struck the tissues in the elm that transport water and minerals. Spread by a tiny beetle, the disease swept virtually unchecked through the entire native range of the species. When the fungus first appeared here, the United States had many millions of American elms; today, only a small fraction are still alive.

The great thing about elm disease

The scourge was not without a silver lining. "We should all be thankful for it," argues the National Arboretum's Frank S. Santamour jr., his tongue only partly in cheek. A lanky geneticist with a silver mustache and a dry, cutting wit, Santamour explains that "the great thing about Dutch elm disease is that it has hit people right where they live." Among the first to come to the aid of the stricken trees was John Parker Hansel of Harrisville, New Hampshire, who, back in 1964, launched a still-thriving organization called the Elm Research Institute. Santamour believes the immediacy of the elm disaster was responsible for kicking the urban-forestry movement into high gear.

That was undeniably the case in Minneapolis. When the disease hit the Twin Cities in 1976, elms comprised 95 percent of the trees there. The plague first swept through St. Paul. Across the river in Minneapolis, a quick-thinking city forester named David DeVoto motivated his fellow citizens to do something. The first time he asked for money to fight the fungus, DeVoto recalls, "there was no response. So I had my men mark 7,000 trees for takedown." Alerted to the impending catastrophe, the taxpayers rallied squarely behind DeVoto. The $1.5 million Minneapolis tree budget was boosted without delay to a robust $10 million.

DeVoto used the additional funds to attack Dutch elm disease head-on. More than 30,000 trees were lost in 1977, and another 65,000 have succumbed since then. However, by maintaining a close watch—identifying and removing diseased elms before the blight



June 15, 1987

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DUPONT ZEPEL

Minneapolis forester David DeVoto stands in front of an elm that survived outbreak of disease in late '70s.

can spread and trimming dead branches (which attract the disease-carrying beetles) from healthy trees—Minneapolis has managed to save nearly 100,000 of its stately elms. Additionally, to soften the loss of the departed elms, DeVoto's crews have planted 60,000 new trees, including street-tough varieties of maple, linden, ash and locust.

In Los Angeles, which never had many elms to begin with, it was dirty air that turned Andy Lipkis into a tree advocate. In 1970 the Forest Service announced that pollution from the Los Angeles basin was killing 40,000 trees every year in a nearby national forest. Lipkis was only 15, but he concocted a plan to enlist volunteers from summer camps to plant large numbers of smog-resistant trees in the dying forest. Then, for the better part of three years, he hustled corporations and government agencies for start-up money. He was routinely shown the door, but he refused to give up.

Early in 1973, Lipkis had lined up enough young campers to plant 20,000 trees, and he arranged for the California Division of Forestry to sell him a corresponding number of pine and redwood seedlings for $500. The problem was, he didn't have the money. He was still scrambling to raise it when he learned that the Division of Forestry had begun destroying the seedlings that hadn't sold in order to plant new ones. "I freaked out," Lipkis recalls. "I started calling Hollywood celebrities, state legislators, anybody who might be able to help. Finally I got a reporter from the *Los Angeles Times* to listen, and he made some calls to Sacramento." An official in the governor's office, fearing a sensational headline in the next day's paper ("State Murders Baby Trees!"), ordered the forestry division to halt the destruction. A few days later, a truck bearing 8,000 bare-root seedlings pulled up to Lipkis' front door. The juggernaut soon to be known as TreePeople was off and rolling.

Next stop: the 1984 Olympics. Los Angeles was chosen to host the event in 1980. The Environmental Protection Agency advised the city that it was one of many that were not in compliance with tough new clean-air standards. The city planning department proposed planting a million trees, which eventually would filter 200 tons of toxic particulates from the air per day. Unfortunately, that project would take 20 years and cost $200 million.

The city turned to TreePeople for help. "I told them we could plant a million trees in time for the Olympics and at a fraction of the cost," Lipkis says. "It was an absolutely insane promise to make." Insane or not, the millionth tree went into the ground four days before the Olympics commenced, and all of that was done without government funding. TreePeople raised enough money to pay for everything.

Since 1977, TreePeople has been headquartered in an abandoned 1920s firefighting camp at Coldwater Canyon Park, a 45-acre ridgetop tract of redwoods, eucalyptus trees and native chaparral perched incongruously above the mansions of Beverly Hills. Their most recent effort: 300 pine saplings planted along a seven-mile stretch of Dr. Martin Luther King Jr. Boulevard this year as a living memorial to the civil rights leader. Lipkis and his team are also devoting much of their prodigious energy to education. Last year TreePeople gave courses in recycling, basic ecology and tree care to 60,000 Los Angeles schoolchildren. "Each kid who comes here plants a tree for our nursery," Lipkis says, "and takes away a seedling—planted by some other student six months earlier—to put in the ground at home. We're trying to inculcate a sense of stewardship at an early age."

Lipkis and TreePeople are presently gearing up to plant between two million and five million more trees in Los Angeles over the next five years in conjunction with the Global ReLeaf campaign. That project's goal is to help combat global warming, which some scientists attribute to the nearly six billion tons of carbon dioxide we add to the atmosphere every year through the combustion of coal, petroleum products and wood. Experts disagree over the rate at which this warming will occur and what the consequences will be. Many

Jon Krakauer once worked as a tree planter. His book about mountain climbing, Eiger Dreams, *is being issued this month by Lyons and Burford.*

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scientists agree, however, that while planting trees is by no means the solution to the so-called greenhouse effect, it is one way to help minimize it.

Enter Global ReLeaf. Trees, as every schoolchild knows, synthesize the carbohydrates they need for growth from carbon dioxide, water, chlorophyll and sunlight. Carbon dioxide, a gas, is pulled from the air; pure oxygen is released back into the atmosphere. The 100 million new trees Global ReLeaf will plant in our towns and cities should rid the air of some 1.5 million tons of carbon dioxide each year.

Even more significant than the carbon dioxide these new trees will remove from the air, though, is their potential to keep it from winding up there in the first place. By cooling cities in the summer months, trees make it possible to conserve a great deal of energy that would otherwise be used to power air conditioners. That, in turn, reduces the amount of coal and oil that must be burned to generate electricity in the first place.

Elmer the Elm Tree hugs his buddy Paul Domholt. They teach Minneapolis schoolchildren about forestry.

The magnitude of the Global ReLeaf campaign is unprecedented, but the notion that trees can be used to modify the urban climate goes back more than 40 years. Stuttgart, Germany, is an industrial center situated in a natural basin characterized by stagnant, polluted air. During World War II, the city made a study of the local climate to see if it was feasible to create an artificial fog whenever Allied bombers approached. After the war, the city fathers and meteorologists used what they'd learned to reduce pollution. "They rebuilt the city," says Rowan Rowntree, who has studied Stuttgart in some detail, "along lines that preserved the forested areas on the hillsides bordering the town. At the same time, the municipal engineers laid out open corridors, lined with trees, that led down from those wooded hills into the city. Air that's been cooled and cleaned by the forests and street-side trees is now channeled down into the city from the hills." The result: measurably cleaner air and cooler summer days.

The success of the Stuttgart experiment has inspired similar studies in Dayton, Ohio, and Salt Lake City, Utah. One aspect of the Dayton research involved placing a topographical model of the entire city into a wind tunnel at the Massachusetts Institute of Technology to determine the effect of trees on summer breezes and winter wind. In Salt Lake City, Rowntree is looking into the possibility of using trees to filter pollutants from the air before the wind can carry them into the nearby Wasatch Range, where they end up in the snowpack that supplies the city's drinking water.

The universal hunger for greenery

Trees soothe the human psyche as well. A study at a hospital in a Pennsylvania suburb revealed that surgical patients whose rooms offered views of trees took fewer painkillers and were released from the hospital sooner than patients whose windows looked out on a brick wall. After conducting a survey of childrens' needs for UNESCO, an urban planner at MIT concluded that the hunger for trees "is outspoken and seemingly universal."

While researchers study how urban trees enhance our lives, a bright new crop of inspired civil servants has been working equally hard to enhance the lives of urban trees. In Fulton County, Georgia, the booming environs of Atlanta, a pioneering ordinance was passed several years ago that's beginning to be emulated nationwide. Authored by a pragmatic, can-do county arborist named Edward Macie, the ordinance fines contractors up to $500 for removing a tree with-

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out prior approval, requires every application for a development permit to be accompanied by a detailed tree-protection plan, and mandates that whenever a permit *is* granted and a tree removed, another must be planted to replace it. The regulation works, says Macie, because "it's wise and flexible, it's backed up by strong enforcement, and businessmen and developers were invited to review and comment on the law, rather than having it rammed down their throats after the fact."

Thirty years ago, few municipalities had an urban forester on the payroll. Now such positions are commonplace, and hotshot practitioners such as Milwaukee's Bob Skiera—a legendary, gnomelike arborist whose car's license plates say "MR TREE"—are in constant demand as speakers and consultants. Skiera has a budget of nearly $10 million to operate a forestry program that's considered a model of efficiency. Every public tree in Milwaukee is catalogued on a computerized data base. Skiera's radio-dispatched crews plant 8,000 trees and prune between 50,000 and 60,000 other trees every year. This is part of a maintenance schedule that attends to each of the city's 330,000 street trees on a meticulous 5.6-year cycle. A preassigned portion of each dollar earmarked for road construction is set aside for the city's trees. "Here in Milwaukee," Skiera explains proudly, "trees are rightly regarded as an integral part of the city's infrastructure—just like lights, sidewalks, streets and sewers. The point is, we don't have to continually go around begging for money."

A new generation of "supertrees"

Over the past 23 years at the National Arboretum, Frank Santamour has tortured, infected and mutilated tens of thousands of trees on a quest to find tough cultivars for uncongenial urban settings, and the work is paying off. For one thing, he and his fellow geneticists have identified scores of existing selections that are able to shrug off indignities ranging from road salt to abuse from overzealous weed-eater jockeys. For another, they have actually bred a number of new "supertrees." The National Arboretum, for example, recently released two new cultivars of *Platanus*, christened "Columbia" and "Liberty," that are resistant to the troublesome sycamore anthracnose blight. In one of the most heartening horticultural developments of late, Eugene Smalley, a plant pathologist at the University of Wisconsin, introduced five new American elm cultivars (all of which go by the name "American Liberty elm") that are supposed to be much less vulnerable to Dutch elm disease than were their unfortunate forebears.

With all the current hubbub about supertrees, cautions Prof. James Clark of the University of Washington's Center for Urban Horticulture in Seattle, "we need to remember that there is no 'perfect tree' and there never will be." The London plane, once considered an ideal city tree, has hyperactive roots that crack pavement and invade sewer pipes. The sweetgum is a wonderful street tree, but in the summer it showers sidewalks with spiny balls. The ginkgo is tough as nails and extremely attractive, but females of the species drop prodigious quantities of squishy, foul-smelling fruit. "All too often," Clark emphasizes, "we have planted our 'perfect tree' in such great numbers that

A lush canopy of mature trees gilds a neighborhood in Newton, Massachusetts, with colors of early autumn.

problems with it can overwhelm us." In post-elm America, diversity is the critical factor. "The rule of thumb," says Santamour, "is not to plant any more than 10 percent of any single species in the same place. Someone made up that rule out of the blue, but it probably isn't too far off the mark."

Rowan Rowntree estimates that tree cover in the typical American city is around 30 percent. The long-term goal of Global ReLeaf is to double that, which means planting 400 million to 600 million trees in the next ten years. Finding enough space for trees and their roots will be a major problem. "A lot of trees will have to be planted in parking lots, business districts and hard-core industrial zones," Rowntree says—in short, in those corners of our cities that are least hospitable. The AFA is confident, nevertheless, that the 60-percent goal can be reached. The trick, according to Rowntree, is to "plant the right trees in the right places. Fortunately, we've been learning a lot about how to do that, lately."

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By Doug Stewart

Nothing goes to waste in Arcata's teeming marshes

A California town proves that ingenuity is a match for high-tech engineering in turning sewage into a natural resource

Heron and leaping salmon adorn the logo for "Flush with Pride" festival held to celebrate the new system.

Crouching by the edge of the marsh, workbooks and pencils in hand, the three third-grade girls peer into the water. On a field trip from a nearby city, they're searching for minnows. A passer-by, strolling along the trail of redwood chips that skirts the marsh, asks the girls if they realize that the water they're hovering over all came from the drains and toilets of the town just across the railroad tracks.

"No way."

"Eeeeeeooooo!"

"Sick-*o*!"

If the girls were townies, chances are they'd know about—in fact, take pride in—the civic duty this little lagoon is so tirelessly performing. The body of water is part of the Arcata Marsh and Wildlife Sanctuary, a 154-acre wetlands park wedged between the foggy shore of Northern California's Humboldt Bay and the small city of Arcata (pop. 15,000).

The quiet and perfectly pleasant-smelling park has turned Arcata, 280 miles up the Pacific coast from San Francisco, into a tourist stop and bird-watching mecca. It also enables the town to meet the state's strict sewage-discharge standards. Since 1986, partially treated sewage from the town's conventional primary-treatment plant has been meandering through the park's chain of man-made marshes. After a two-month odyssey, it's piped into Humboldt Bay. The discharged marsh water is generally clearer and cleaner than the water already in the bay.

"Traditionally, people think of wastewater as something to get rid of," says Dave Hull, the Public Works Department's bearded young aquatic-resources specialist. "Here, we think of wastewater as a natural resource." The system's low-key simplicity won the city a $100,000 grant from the Ford Foundation's Innovations in Government program, and has set off a flood of inquiries from mayors and town engineers around the country.

Contrary to popular belief, raw sewage (or wastewater, as engineers prefer to call it) is 99.9 percent pure H_2O. "Every time you flush the toilet, that's another five gallons of water down the drain," Hull explains as he stands over a metal grate set into a concrete slab at the town's headworks. Below his feet, fresh sewage arriving straight from town gushes from a large pipe into a holding tank. Nearly half of the outpouring is from toilets; most of the rest is from kitchen sinks, showers, bathtubs and washing machines.

The sewage flows to an enormous, open-air concrete tub a few yards away, where coarse solids—fecal and food wastes—settle to the bottom. The town used to spread the dried sediment, or sludge, around the city parks as mulch, but state health codes put an end to

Amid bullrushes, pennywort stems, a coot feeds on duckweed in one of Arcata's several man-made lagoons.

Photographs by Ted Streshinsky

that: disease-causing parasites could lurk in the untreated residue. The town is now considering treating the sludge by simply composting it, then spreading it around Arcata's 1,200 acres of upland redwood forests.

As for the wastewater that's drained off from the tub, it's channeled to a pair of large oxidation ponds near the headworks. There and in the marshes farther along the chain, Arcata does the same thing with its sewage that other towns do: it lets the appetites of various one-celled microbes go to work on the organic ingredients. The alleged state of the art in sewage treatment employs huge concrete vats that break down the "mixed liquor" (sanitary engineers love euphemisms) with the aid of compressors, mixers, aerators and diffusers. Arcata, in contrast, abets the biological process in a far more leisurely fashion.

Dave Hull's former teacher Bob Gearheart helped design Arcata's waste-fed string of lagoons. A professor of environmental engineering at the local college, Humboldt State University, Gearheart has a penchant for low-cost, low-energy technologies. Among other projects, he has helped set up crop-irrigation systems using wastewater in several Third World communities. In a developing country, he found, high-quality fresh water was often unavailable and chlorine unaffordable.

In Arcata one recent morning, Gearheart stands at the edge of Gearheart Marsh (a name for which he disavows responsibility) and riffles one hand through a dense thicket of cattails growing in the shallow water. "What really does the work here are the microorganisms that grow around the roots and stems of these plants," he says. Gearheart Marsh is the second of three so-called enhancement marshes that are fed by smaller marshes farther upstream. Each enhancement marsh has a balance of open water and marsh plants. The shapes of the marshes are pleasantly irregular, and small man-made islands punctuate their surfaces. Gearheart, a solidly built Texan who's wearing a scuffed leather bomber jacket and sneakers, grabs a cattail and yanks it out of the mud, roots and all. "Smell the hydrogen sulfide? That's anaerobic bacteria at work," he says. The stem is slippery, evidence of underwater bacteria and fungi that have latched onto it to feed on the organic nutrients in the water flowing past—tiny biological filters, in effect.

Earlier, air-breathing bacteria have already taken a shot at breaking down the sewage into less-noxious components. This happened in the unvegetated oxidation ponds that are at the head of the chain of lagoons. Oxidation ponds were once a standard feature of sewage treatment plants, and they're still used in thousands

Doug Stewart is a freelance writer in Massachusetts. A frequent contributor to SMITHSONIAN, *he last wrote about the toy industry in the December 1989 issue.*

A woman and baby stroll one of wood-chip paths that meander some five miles around park's marshes.

The city of Arcata, here nestled in redwoods, has a reputation for unconventional solutions to problems.

Peter Menzel

George Allen (left) and Bob Gearheart were two of the masterminds behind Arcata's innovative system.

Dave Hull opens a grate at wetlands pumping station, the end of the line for the sewage's marsh odyssey.

of small towns with plenty of land and not too many toilets. Unfortunately, they're prone to algae blooms, which worsen water quality instead of helping it. Oxygen and nitrogen levels, in particular, can swing wildly as the algae alternately prosper or die off. Adding the string of plant-filled marshes, Gearheart says, has put a stabilizing buffer between the oxidation ponds and the bay ("polishing the effluent" is the phraseology that engineers have come up with). As a precaution, wastewater is chlorinated soon after it leaves the oxidation ponds; this kills any disease-spreading germs, but the chlorine dissipates quickly, so it does no harm to plant and animal life.

An eye on recycling opportunities

All this nutrient-rich swamp water does for plant life what spinach does for Popeye. Duckweed, cattails, pennywort and hard-stem bullrushes flourish in the enhancement marshes. Breaking open a cattail, Gearheart reveals its mealy, white interior. "This is just starch, like a potato," he says. To keep the marsh plants from crowding out the open water, the city plans to drain the marshes every few years, and harvest the rushes and cattails with farm equipment. Always on the lookout for recycling opportunities, Gearheart hopes the city will let the starch ferment into ethanol, useful as a fuel. "Cattails are one of the most efficient ways you can get biomass per acre," he notes.

The wetlands flora, in turn, attract astounding numbers of waterfowl: ducks, coots, egrets, herons, hawks, avocets, pelicans. Altogether, naturalists have tallied close to 200 bird species in the sanctuary, double the number of just a few years ago. Otters, voles, mice and muskrats rummage in the thickets onshore. On a recent afternoon, a man-made lake was ringed by telescopes on tripods, all focused on a peregrine falcon singlehandedly giving the heebie-jeebies to several thousand marbled godwits. Nearby, a brown pelican crash-dived into the lake for trout. Onshore, a great egret struggled to swallow a field mouse, finally washing it down with a gulp of lake water. Joggers huffed down the redwood-chip trails, and office workers on their lunch breaks sat reading in parked cars. Directly and indirectly, sewage made it all happen.

The outpourings of Arcata's toilets have become a source of civic pride—and humor. The town inaugurated its new sewage system by holding a "Flush with Pride" festival. Citizens wore T-shirts emblazoned with the festival's logo, a salmon leaping out of a toilet as a great blue heron perched on the seat. A visitors' center is being planned for the park, and there's talk of posting signs inside its toilet stalls that will read: THANK YOU FOR YOUR CONTRIBUTION. "We're using a product that almost everybody wants to get out of their minds," says

Turning sewage into a resource

Frank Klopp, Arcata's public works director, "and we're having fun with it." Klopp is a raspy-voiced, wise-cracking former forester who's listed as "Klippity" on the magnetic In-Out board outside his office.

Klopp says, "You wouldn't believe how many public-works directors call me up and say, 'My mayor asked me to call you and ask about your system. It really won't work for our town, will it?' " Klopp shakes his head. Politicians are intrigued by what Arcata is doing, he says, but engineers tend to be dubious. "A consulting engineer from another town called me the other day and hit me with a classic. He said, 'We can't have people walking around our waste treatment plant!' "

Klopp tells whoever asks him that any town with both oxidation ponds and ample public, low-lying wetlands can use its sewage to build a marshland park. A seacoast isn't necessary, he says, nor is a tiny population. Arcata is the first American city to build a public park and wildlife sanctuary with its sewage, Klopp believes, but now larger cities are borrowing some of its ideas. Hillsboro, Oregon, with twice Arcata's population, is contemplating a system of more than 1,000 acres of waste-fed wetlands. The wetlands would clean up Hillsboro's sewage enough for it to be dumped harmlessly into a local river. Landlocked Santa Rosa, California, with more than 100,000 inhabitants, plans to run a portion of its sewage through several hundred acres of ribbon-shaped wetlands, hoping to reestablish trout and salmon in nearby streams in the process. A key constraint for any town contemplating wetlands treatment, Klopp says, is that household sewage not be overwhelmed by either untreated industrial waste or storm-drain runoff. Each of these can upset a wetland's fragile ecology by sweeping too many microbe-killing pollutants into the mix.

Arcata's unusual toilet-to-marsh-to-sea operation would probably never have gotten started were it not for George Allen, a fisheries professor at Humboldt State. In the late 1960s, Allen was looking for a freshwater creek where he could study salmon with his students. Most of the local creeks had either been buried, diverted or otherwise rendered inhospitable to fish. Filling ponds with tap water was too expensive. In need of an alternative, Allen began siphoning off wastewater from Arcata's oxidation ponds.

Allen, now semiretired, is hoping to get salmon to imprint on the unique flavor of Arcata's sewage. Long after they've headed downstream and out to sea, salmon can recognize the exact mix of ingredients in the freshwater streams and ponds they grew up in. After months or even years as oceangoing adults, they try to return there to spawn. If Allen's pilot project works, the city of Arcata may take up fish farming for fun and profit. In a reversal of the NIMBY (Not In My Backyard) syndrome, Arcata would take what other towns banish, and grow protein in it.

It was Allen's incorporation of sewage into the food chain that first got others in town to thinking. By the mid-'70s, stringent state sewage-discharge rules had caught up with Arcata and its neighbors. For years, Arcata had simply dumped treated wastewater from its oxidation ponds directly into Humboldt Bay. An expensive new regional sewage plant was being planned, and the state was pressuring Arcata to pay up and tie in. The plant was to be the latest thing in high-tech sanitary engineering. One design option called for revolving drums, close to ten feet in diameter, that would agitate a tankful of sewage in the way a paddle wheeler churns upstream. A slimy coating of bacteria on the drums would gulp air on the upswing, force-feed on the down. In five or six hours, the job would be done. The plant, whatever design was used, would be big—big enough to handle a flow of 40 million gallons a day without choking. And expensive: by 1976, the estimated cost of building it had passed $50 million.

Arcata's self-image was on the line

Klopp, Gearheart, Allen and others, meanwhile, had begun exploring the idea of running Arcata's sewage through marshes instead. They drew up plans for ponds that would be dug out of 32 acres of desolate waterfront land where a series of abandoned and decrepit lumber mills stood. Dominating the debris-covered site was the old county dump. When Gearheart et al. pitched their better idea, the city councilors and a majority of its voters were won over. Homeowners dreaded the prospect of soaring sewage-treatment costs if the new regional plant were to be built. Moreover, Arcata's civic self-image was on the line. The town had long prided itself on being something of a countercultural bastion, even by Northern California

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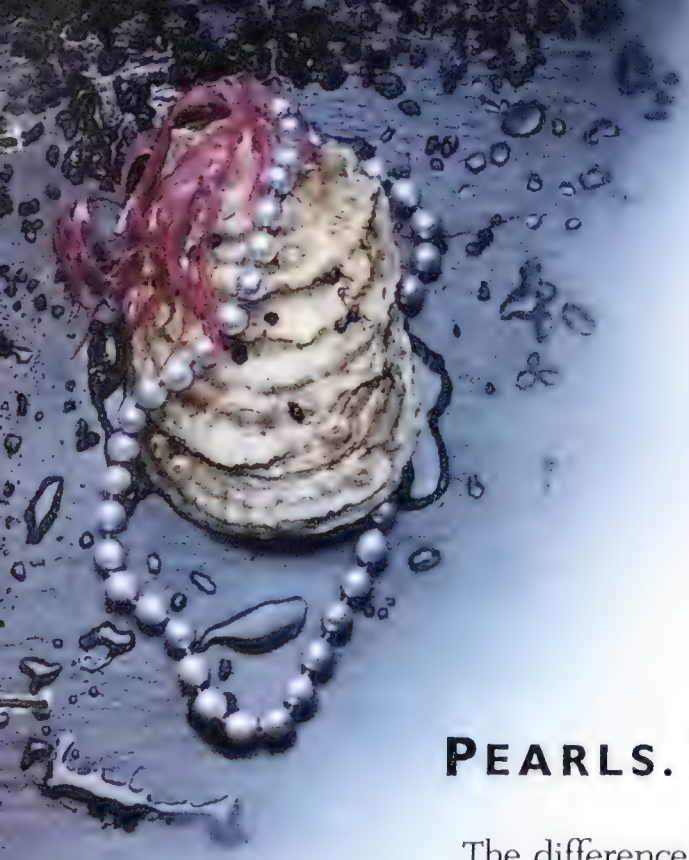
standards. Arcata is the sort of community where men still wear ponytails, VW buses are common and the town library, as part of its Hassle Reduction Program, no longer fines delinquent borrowers.

Arcata's marsh-building plan touched off a bureaucratic squabble. The town fought stubbornly to extricate itself from the regional plant tie-in while battling a phalanx of skeptical state and regional agencies. Says Gearheart, "The perspective of the agencies has always been: contain, treat, discharge, with no other uses." Arcata eventually prevailed. The regional plant was scrapped, and Arcata began building marshes, but with two conditions. It had to monitor water quality strenuously throughout the marshes (a requirement that has driven up the cost of the system) and, just to be safe, it had to chlorinate the effluent a second time, after the trip through the marshes ("which is ridiculous," Frank Klopp grumps).

Leaning back in his office chair after an extended lunch hour spent at Klopp Lake with his daughter and a bag of popcorn, Klopp expounds on the virtues of sewage marshes. The system is cheaper than a conventional plant would be, though not dramatically so. Besides that, "It's fun." Had it not been for the park's vital public works function, the town could never have afforded such a sprawling recreation area, which is complete with landscaping, park benches, bird blinds and groomed trails.

Klopp, at 55, is a keen outdoorsman who hunts deer and pheasant and dives for abalone. The walls of his small office bristle with no fewer than eight sets of deer antlers. That his department built and manages a public-works facility that doubles as a teeming wildlife sanctuary is a source of great pride, with or without the lake named after him. And though he's an engineer, the unmechanized simplicity of the marshes pleases him. "Managing the marshes is absolutely no problem," Klopp says. "It's not like you go out there and turn the wrong valve and everything blows up. The biggest problem we have is how to raise enough ducks." Asked why the town needs ducks, Klopp stares at his questioner in amazement. "Why else would we want to grow a marsh?" he says. "You think we did all this just for water quality?"

Semi-fish-eye view of Hauser Marsh dramatizes its luxuriant carpet of vegetation, stands of pine trees and grassy banks. Because so many plants and animals thrive in the sanctuary, it is a nature lover's paradise.



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GILGAMESH AND GLOBAL WARMING

It was meant to be edifying; the story of a heroic king, Gilgamesh, who overcomes nature to cut down a magnificent cedar forest. But now, 5,000 years later, to sensibilities attuned to a perishable environment, the story is shocking.

The cedar forests of Lebanon were an invaluable resource to the ancient Sumerians. Cedar was a primary building material for their growing cities on the Mesopotamian plain. It was integral to their vigorous economy. The loss of a forest seemed a small price to pay for empire.

It is only now, after fifty centuries of paying small prices for the progress of civilization, that we are beginning to appreciate the true cost.

Gilgamesh, Steve Huston, 1990

Yet the destruction goes on. Even as you read this, thousands of acres of irreplaceable forest are being destroyed for farmland, for houses, for furniture, even for chopsticks.

The loss could be far greater than aesthetic. Evidence is mounting that the forests play a vital role in the regulation of the atmosphere's carbon dioxide level. Without trees, CO_2 levels may rise unchecked, and consequent global warming may accelerate – with unpredictable effects on all life.

Technology itself has often been cast as the miscreant in this problem, but it is the misuse of technology that bears true responsibility. Wisely used, it can actually improve the environment. While the Sumerians may have abused the forests of Lebanon, they also employed their technology to transform a desert into a vast garden.

Our own technology can actually be a boon to nature. Indeed, our country's space program itself has given us, for the first time, the perspective to study the whole earth as a single ecosystem.

Lockheed has been there from the beginning. Our work with NASA on space systems is well known, but the achievements of Lockheed environmental scientists have been, until now, unsung. From Love Canal, to the National Acid Rain Survey, to the cleanup of the Prince William Sound oil spill, we have set whole new benchmarks in the study of global pollution, and what can be done about it.

Not since intelligent life appeared on the planet has humanity had to concern itself with the consequences of its own genius. What we do in this generation may very well determine whether the future earth will be a garden, or a desert.

Lockheed

Giving shape to imagination.

By Michael Parfit

Earth First!ers wield a mean monkey wrench

Convinced that genteel approaches won't win the war, these activists go to extremes to slow the demise of the natural world

On the 31st of May, 1989, Dave Foreman woke with three pistols pointed at his head. "FBI!" a voice said. "You're under arrest!" In September, Foreman's book *Ecodefense: A Field Guide to Monkeywrenching*, attacked in a daily newspaper for its intricate descriptions of how to damage everything from aircraft to bulldozers to computers, was a best-seller in the Pacific Northwest. By the end of 1989, as the date of Foreman's conspiracy trial approached, even David Brower, the founder and chairman of the Earth Island Institute and archdruid of environmentalists, was his fan. "I would love to introduce him," Brower told me in October. "I would hate to follow him. He's a terrific performer." By early 1990, like a few other Americans who have also advocated lawlessness in pursuit of lofty goals, Dave Foreman had become a partisan hero.

His admirers are members of the growing alliance of people who have taken to the streets and the woods to escalate a conflict that has haunted the environmental movement for decades—whether the natural world is a place to manage or a place to revere. To them protecting the Earth has become a war.

There's another way to trace this group's rise to prominence in 1989. It can be found in court records and on police blotters: in January six people were arrested when they hung a banner over the National Western Livestock Show's opening day parade in Denver. The sign read: "Livestock destroy our public lands —stop welfare ranching." In February a logger in Washington State arrived at a work site and found that someone had put sand and saltwater in the fuel, water and hydraulic systems of several pieces of equipment, causing damage, he said, that totaled $187,000. In May the FBI arrested four people, including Dave Foreman, for alleged conspiracy to damage power lines and towers leading to and from nuclear power plants; an undercover FBI agent had recorded conversations by using microphones concealed on his body. In July a road grader was deliberately set on fire in Washington State's Okanogan County. In September three people were arrested while blockading a logging road leading into the Trail of Tears State Forest in southern Illinois. In December metal spikes were found driven into trees in northwestern Montana, an attempt to prevent them from being logged. A letter found near one tree concluded, "Keep it like it was."

"Burn that Dozer!" Dave Foreman sang one night last September, standing with a crowd of about fifty beside a campfire in the Adirondack Mountains. It was the Northeast Rendezvous of Earth First!, the radical environmental group he helped start in 1980, and which has been accused of many of these actions. He stood in the cold air, firelight on his face, wearing his trademark down vest and floppy camouflage hat. On his T-shirt was the shape of a raised fist, surrounded by the Earth First! slogan: "No compromise in defense of Mother Earth." Foreman raised a bottle of beer and spoke for ten minutes. "It ain't junior high anymore," he said near the end. "They don't just send you to the principal's office. Some of us are going to spend a lot of time in jail. Some of us are going to die."

Humor, self-sacrifice and violence

I was standing by the Earth First! fire myself that night, knowing that some of the people around me could be undercover FBI agents, sheriff's deputies or other writers. Like all those others, I was trying to learn more about a faction of the environmental movement that, driven by a sense of crisis, brings tactics like rowdy humor, civil disobedience, personal self-sacrifice and violent attacks against property into a political field hitherto known for its propriety.

"Mainline conservation groups came out of a more genteel era," said one radical environmentalist who calls himself "The Man Who Walks in the Woods." "The causes were noble, but not essential. That had its day. But now the stakes are getting too high."

This century's classic conflict over land use has been drawn on lines that go back to Emerson and Thoreau, but were clearly represented by the conflict between John Muir and the first chief of the U.S. Forest Service, Gifford Pinchot (see page 35). Pinchot, who put the

Valeri Wade perches atop yarder, a 90-foot-tall rig to pull logs uphill, during protest in an Oregon forest.

Photographs by David J. Cross and Greg King

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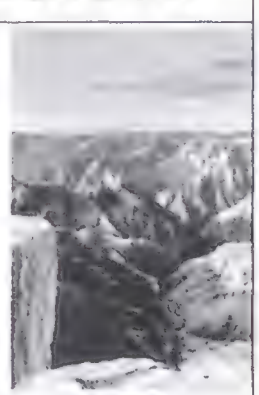

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term "multiple use" into practical application, saw the land as a resource to be exploited carefully but fully. Muir wrote of mountains as cathedrals, and gave emotional force to an idea that Aldo Leopold later described more explicitly: "We are only fellow-voyagers with other creatures in the odyssey of evolution."

In this conflict between management and hands-off preservation, Foreman and his friends come down hard on the side of preservation. "We have a heightened, distinctive empathy for nature," one Earth First!er told me. It is a love for the planet and its many manifestations of life, a love that distrusts both science and traditional religions. Foreman and other radicals want a revolution in which humans become just another wild species on a wild planet.

It is an apocalyptic view. Some radical environmentalists see famine and death approaching; others see armed conflict. "Right now we're in the early stages of World War III," says Paul Watson, international director of Sea Shepherd (the organization that fights whalers and others who kill or capture marine mammals) and captain of the *Sea Shepherd*, one of the ships it operates. "We are the navy to Earth First!'s army," says Watson. "It's the war to save the planet. This kind of action will be getting stronger. The environmental movement doesn't have many deserters and has a high level of recruitment. Eventually there will be open war."

This is not just some form of weird mutant environmentalism. It has grown, like the conflict it embodies, from logical roots. Watson, whose organization has rammed, sunk or otherwise disabled 12 whaling ships, came into radical environmentalism out of the turmoil of the late '60s and early '70s: he served as a medic in the American Indian movement's occupation of Wounded Knee, South Dakota, in 1973, before taking up the cause of seals and whales. Earth First!, the most active and notorious homegrown radical environmental group in the United States, grew out of the

Dave Foreman, cofounder of the radical environmental group, addresses students at Reed College in Portland, Oregon.

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A novel by the late Edward Abbey inspired the group's monkeywrenching.

lobbying by environmental groups in the late '70s.

In those days Dave Foreman, a former horseshoer from New Mexico, was working for about $1,100 a month as chief lobbyist for the Wilderness Society in Washington, D.C. This was not as sedate as it might seem.

"We prided ourselves on being buckaroos," remembers Tim Mahoney, who worked with Foreman at the time and until recently was a lobbyist for the Sierra Club. "We could outstomp and outdrink the others. We wanted to show that to be for wilderness you didn't have to be an effete Brie-eater. You could drink beer and play country music and be an outlaw. We were not giving any ground to the other side in redneck ethic. We weren't going to concede who were the cowboys."

Mahoney, Foreman, Foreman's wife Debbie Sease, and Sease's ferret lived in Rosslyn, Virginia, in an old house they called the Buckaroo Bunkhouse. The Wilderness Society field representatives who regularly visited the Bunkhouse recalled the huge, growing stack of empty beer cans in one corner, the mixed aromas of old

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beer and ferret, the dead rats hanging on the back porch like pelts, the sound of Willie Nelson and Waylon Jennings on an album called *Wanted: The Outlaws*, and late-night conversations about how the environmental movement needed some extremists.

"We thought it would have been useful to have a group to take a tougher position than the Sierra Club and the Wilderness Society," Foreman remembers. "It could be sort of secretly controlled by the mainstream and trotted out at hearings to make the Sierra Club or Wilderness Society look moderate."

The buckaroos' trouble was that they shared the views of Muir but felt compelled by political considerations to use Pinchot's framework for argument.

"As early as 1971," Foreman says, "I believed in wilderness for its own sake. But throughout my eight years with the Wilderness Society I kept the intrinsic-value approach quiet."

One of the buckaroos' favorite texts was a book that had been printed the year before the Outlaws album was released: Edward Abbey's *The Monkey Wrench Gang*. The novel is a rowdy, romantic story about three men and a woman who go on a gallant rampage throughout the Southwest on behalf of wilderness. They

Howie Wolke waves a monkey wrench, the EF! trademark, during a rally.

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Crack in the dam with Muir graffitto was painted by Earth Firstlers at Hetch Hetchy Reservoir in Yosemite in 1987.

burn bulldozers and mining equipment; they pull up survey stakes along new roads; they plot to blow up one of this century's great symbols of the destruction of beauty, Glen Canyon Dam in Arizona. And they generally peck away at industrial order.

"That was a fun book," Mahoney remembers. "We said, 'Yeah, that's what you ought to do.' "

In 1979 the Wilderness Society's management changed. Some of its underpaid buckaroos were replaced. Dave Foreman quit; he and Debbie Sease were separated. She and Tim Mahoney stayed in the business, moved over to the Sierra Club as environmental lobbyists. The ferret was traded in for an aquarium; the beer cans were recycled. Eventually the Buckaroo Bunkhouse was torn down and turned into a high rise. But Foreman, with four other friends, went for a biblical kind of hike in the Pinacate Desert of Mexico. There they thought more about John Muir, Aldo Leopold and the Monkey Wrench Gang, and said again to one another: "Yeah, that's what you ought to do." By the time they came back, they had started Earth First!

The centerpiece of the cause they brought home with them was a drive for the preservation and expansion of wilderness, not for recreation but for survival. "We need biological wilderness rather than backpacking reserves," Foreman says now. In the words of Howie Wolke, one of the five, "Wilderness is the germ plasm of evolution." Writing recently in *Earth First!*, the group's journal, Wolke said: "The American environmental movement (wilderness advocates in particular) is out to lunch, bloated and addicted to bologna and mayo on white. Simply put, it has failed, miserably, to connect the wilderness issue with planetary survival."

So the movement the five men started was not, after all, controlled by the mainstream, and it wasn't docile enough to be trotted out like a trick pony. "We let off a lot of steam for the first couple of years," Foreman said recently. They pulled up survey stakes; they lowered a long piece of black plastic over the front of Glen Canyon Dam to look like a crack; they did things in the Monkey Wrench

Michael Parfit reported on Brazil's rubber tappers in November 1989. His latest book is Chasing the Glory.

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2 a.m.: Catching another 40 winks.

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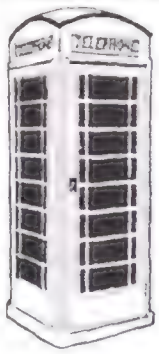

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Gang tradition that they don't discuss.

To take their message to the people, the founders of Earth First! started giving what they called "road shows." A typical road show by these "rednecks for wilderness" consisted of speeches by Foreman and music by another of the founding five, Bart Koehler, who called himself Johnny Sagebrush and sang songs with cheerfully overt lyrics—such as "Monkeywrenchin' ":

> You grab a wrench. I'll get the Karo syrup
> Picks and shovels and wire cutters too
> Iron filings and sugar for the gas tank
> Then I'll show you what we're gonna do.

At a road show in Northern California in 1981, Foreman met Bill Devall, a sociology professor at nearby Humboldt State University. Devall was a leading academic proponent of the concept of deep ecology, in which human beings are seen as no more or less important on Earth than trees, birds or even viruses. The philosophy is an extension of many of the ideas of Thoreau, Muir, Leopold and others, but, like Earth First! itself, takes a more militant stance against the resource management approach.

In their 1985 book, *Deep Ecology*, Devall and coauthor George Sessions write that "increasingly intensive management produces a host of unintended consequences which are perceived . . . as real and severe problems. The usual approach, however, is to seek ever more intensive management, which spawns even more problems." Deep ecology, they write, implies instead that "the well-being and flourishing of human and nonhuman Life on Earth have value in themselves. . . . These values are independent of the usefulness of the non-human world for human purposes." The explicit principles Devall and Sessions set forth include a decrease in the human population, a fundamental change in policies of "human interference with the nonhuman world" and a demand

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for activism among those who think the same way.

Earth First! embraced the philosophy whole. "We say that the ideas and manifestations of Industrial Civilization are anti-Earth, anti-woman and anti-liberty," says an Earth First! publication. "We are working to develop a new biocentric paradigm based on the intrinsic value of all things: Deep Ecology." Earth First! jumped into wilderness disputes all over the United States, but most actively in the West, where it was one of the first environmental groups to get involved in trying to protect old-growth forests.

Many of the group's tactics have been developed and refined in that conflict, including civil disobedience actions like sitting for days on platforms suspended from threatened trees, rewriting billboards ("Coors: Waste the High Country") or driving spikes into trees to threaten damage to saw blades. (A sawmill worker was injured in 1987 when a bandsaw broke on a spike; no person or group has yet been charged with having driven the spike, however.)

Its tactics and hard-line stance in favor of closing all land to new development also exposed Earth First! to harsh criticism. Cecil Andrus, a highly respected former Secretary of the Interior, accused Foreman of "destroying the environmental movement to sell a few books and make money." Others compared tree spiking to putting razor blades in Halloween candy.

"Extinct" was spray-painted on grizzly bears that guard Klamath River bridge.

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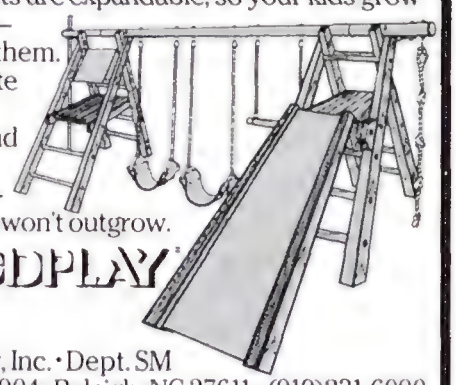

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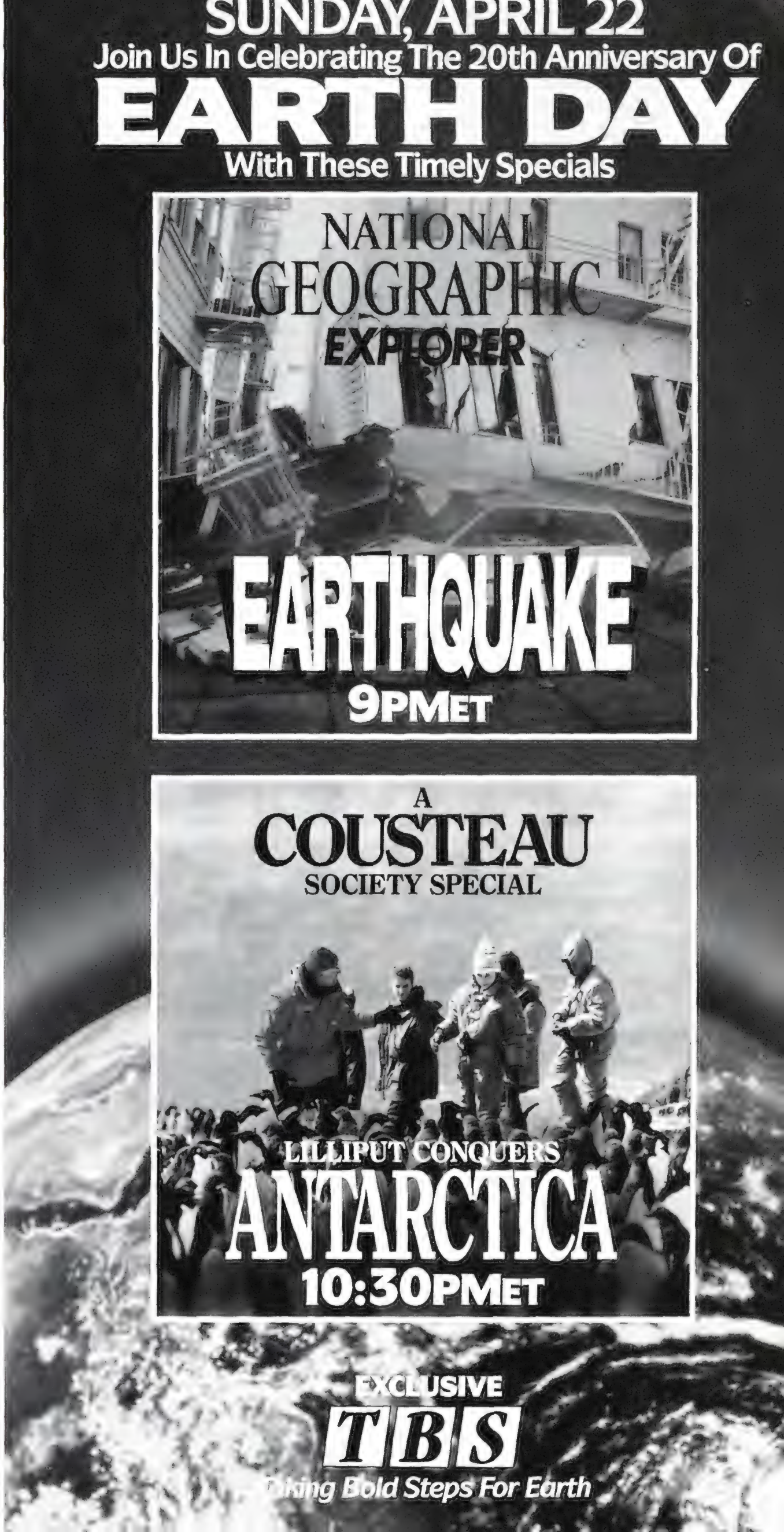
Mary Beth Nearing relays messages during a protest in the Pacific Northwest.

But by the time the Earth First!ers gathered in the Adirondacks as part of a growing presence in the Northeast, the group was almost an establishment in itself, with a regular journal, a semiattached foundation, textbooks and culture.

The Adirondacks meeting was a curious combination of sincerity, bombast, anger, pragmatism and spirituality, a mixture I had encountered earlier in Montana. On Sunday morning one large group of Earth First!ers sat in a circle listening while Mary Beth Nearing, a small, cheerful woman who has been arrested eight times while protesting, twice for sitting in trees during protests over logging, gave a workshop on civil disobedience. "You take the pain of the trees on yourself," she said. She covered everything from whether or not to go limp to how to plead before the judge. "Often you get a suspended sentence," she said; "then you can start your period of probation, and in a year or two when it runs out you're ready to be arrested again." The group listened, rapt.

"There's a kind of magic that happens when you do an action," she



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said. "You can be up all night, then alert all day. There's a sense of magic, calmness, clarity. It's a life experience you cherish."

At the same time, in another clearing, a different group sat in a circle seeking other forms of magic. It was an exercise called a Council of All Beings, originated by Australian activist John Seed. At a Council of All Beings, you choose a nonhuman form of life and meditate upon that form—mouse or tree or stem of grass—until you seem to be that stem or mouse, and then you tell the others in the circle about lawn mowers or traps, and how it feels to be oppressed by humans. The Council of All Beings reminded me of a form of religious worship that had taken place at the Montana rendezvous I had also visited. There, the worshipers had evoked the presence of Gaia, a name for Earth as a being or a goddess, which is taken from the more scientific theory known as the Gaia hypothesis, in which Earth is described as an organism. The ceremony had been self-consciously pagan. "If you're going to talk about Christianity," a Montana worshiper had said, "please leave."

When I asked Dave Foreman, still in vest and camouflage hat, what the Council of All Beings and Gaia-wor-

Voodoo pins pierce a Forest Service symbol in an Earth First!er's microbus.

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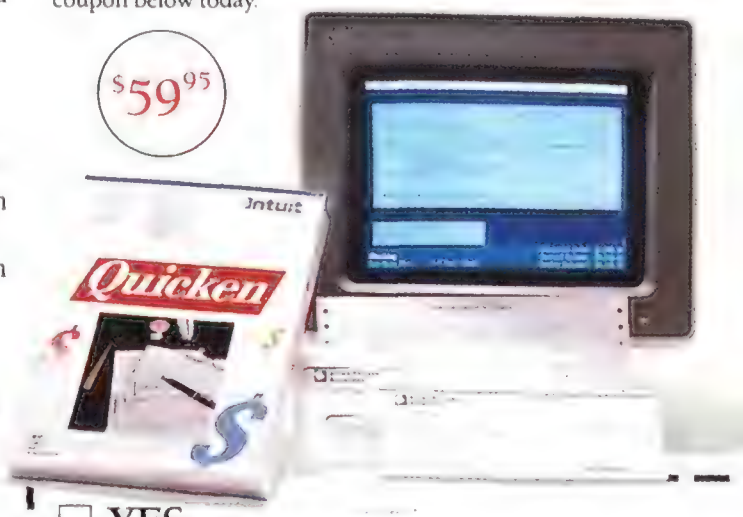

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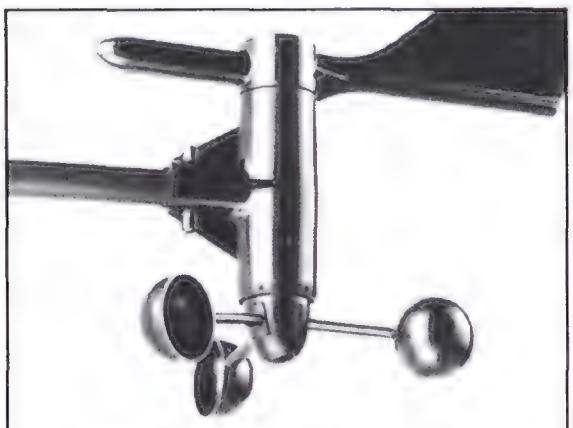

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ship role was in Earth First!, he grinned. "That's the woo-woo stuff," he said. "It's beyond me. But the diversity's good."

Sometimes Earth First!ers seem so varied that it looks as if the same battle, between the pragmatic and the spiritual, is going on inside as well as outside the group. "Until '86 we were glad to be rednecks," said one young old-timer, Roger Featherstone, the speaker at an Earth First! road show called "Greenfire." "Now everybody's a vegetarian, eating soy cheese." In California, I talked with an Earth First!er named Darryl Cherney, who was rather diverse all by himself. Cherney, whom I ran to ground in a Mexican restaurant with a half-dozen allies, is a leader in a battle to save old-growth redwood trees on the northwest coast of California.

"I'm not an environmentalist," Cherney said solemnly, dipping a chip in salsa. "I'm an Earth warrior. I am the Earth defending itself. I'm trying to de-domesticize myself. I'm trying to feralize myself."

From down the table floated the voice of a more pragmatic friend. "Ah," said the friend, "Feral Darryl."

Cherney ignored him. "Once you start thinking biocentrically," he continued, "you start to see everything in a new light. This is not a napkin, it's a tree. The language becomes different. If you want to call someone something bad, call him a human."

Earth First!ers' love for the land's beauty also drives hate. An essay in *Earth First!* once described AIDS as "a welcome development in the inevitable reduction of human population." Another column, headed "Sleaze from the Slickrock," announced in June 1989: "The good news is that Cal Black, San Juan County Commissioner for 24 years . . . implacable foe of wilderness, and king of the sagebrush rebels, has incurable lung cancer. . . ." One speaker at the Adirondacks rendezvous, asked what he thought the optimum human population of Earth should be, answered "Zero."

Mike Roselle, Greg King and Darryl Cherney, with the Spikettes, sing "The Ballad of the Lonesome Tree Spiker" at Grand Canyon rally.

Earth First! is condemned by representatives of industry and by some other environmental groups, partly for these antihuman expressions. But nowhere is the attack more fundamental than from within the radical environmental movement itself. Ironically, it's on familiar lines: management versus reverence. "The deep ecology crowd keep repeating the same mantras all the time," says Murray Bookchin, who has been a radical environmentalist for more than 30 years and has been active in the development of "Green" political movements worldwide. The deep ecology movement, he says, "looks at human beings the same way you see them from the Empire State Building. Deep ecology blames humanity, as if there's no rich and poor. They say human beings are just a troublesome species, as if we don't come out of nature."

Bookchin is an advocate of social ecology, which holds that ecological problems stem from social problems. We have to learn to live in harmony not only with nature, Bookchin maintains, but with one another. "The natural thing is for humans to intervene in nature," he says. "The question is whether to intervene destructively or creatively."

Green political parties around the world are as concerned with society as

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they are with nature. They, too, generally seek to change the way Earth is managed, not to replace management with a wild love. "We may need to use a great deal of technology to save the planet," Bookchin says. Earth First! sees technology as the enemy itself; it chooses to intervene with creative destruction.

Foreman identifies three parts of the Earth First! theme: ecological wilderness, civil disobedience and monkeywrenching. But it is the last that has made the group's reputation as a force to be reckoned with.

"Finally," Foreman wrote in *Ecodefense*, "go out and *do* something. Pay your rent for the privilege of living on this beautiful, blue-green, living Earth. Monkeywrenching will succeed as a strategic defense of the wild only if it is enthusiastically and joyously undertaken by many individuals in many places."

A spotted owl protests proposed mountain lion hunting in California.

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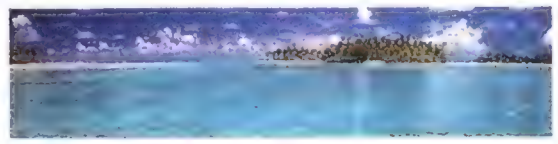

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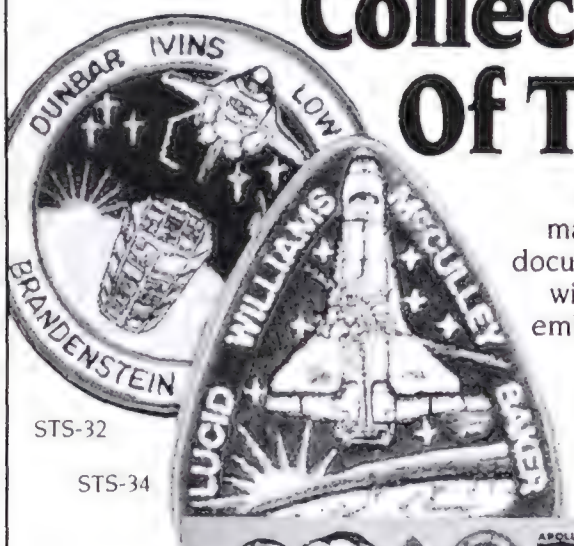

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Monkeywrenching, Foreman likes to say, is as honorably revolutionary as the Boston Tea Party. It is often at least as creative. Earth First! warriors, *Ecodefense* suggests, should pour epoxy or concrete in open sewage pipes in condominiums under construction, so that when the development is finished the new owners won't be able to flush. Or, it says, you should use an X-Acto knife with blade style 23x to slash the tire sidewalls of "off-road vehicle scum." Other saboteurs have their own creative instincts. In Idaho, someone once attacked a controversial wilderness airport by spreading rock salt on the runway; elk, pawing at the soil for the salt, dug holes in the runway. And, on the *Sea Shepherd*, I saw a huge water gun; it would be used to splurt whalers and drift netters with 50-gallon globs of cream pie.

Does all this breaking of laws and equipment work? None of the victims would like you to believe it does. "I don't know of one timber sale that has been stopped by tree spiking," a U.S. Forest Service silviculturist said in Washington State. "Monkeywrenching doesn't work," said an Audubon Society official, also in Washington. "Most of the progress on the ancient forest issue has been made by the Sierra Club Legal Defense Fund." In some ways monkeywrenching could be seen as the James Watt of environmentalism: it galvanizes the opposition. In fact, Watt's old organization, the Mountain States Legal Foundation, now has a telephone line specifically for reporting monkeywrenching incidents.

But some people still don't see crafted compromise as progress. "Everywhere we turn we find that the avenues to provide change are not open to us," said Judi Bari, who works with "Feral Darryl" Cherney in Northern California. And, loving Earth as they do, some see a violent dictatorship in the management of the planet by industry, a rule as murderous as the worst offenses of humans against their own kind.

"If you were in Nazi Germany would you feel it appropriate to monkeywrench?" asked an Earth First!er. "The question is when."

"If people think Earth First! is violent," said David Brower, "they'd better stop the frustration that's going to lead to a lot worse." To some, future violence may not be restricted to equipment. "If I or my daughter were dying because of Love Canal," Paul Watson said, "the president of Hooker Chemical would be a dead man."

I encountered monkeywrenching firsthand only once, and then it was only noise. I was on a trip in Washington State with a group that included two men from the Forest Service, several people from the Audubon Society and one Earth First!er, whose name was Mitch Friedman.

Roselle (raised fist) and Randy Hayes (bent knees) lead a chorus of "Monkey Wrench Blues" during 1986 annual rendezvous in Idaho.

We had been driving from clear-cut to clear-cut, talking about the issues of logging old-growth forest, northern spotted owls and management. Once during the trip we stopped by a field of stumps and splinters that had been forest the year before. The Forest Service silviculturist talked about managing for wildlife values. Next to the field stood a wall of old-growth forest: dark columns of mountain hemlock, western red cedar and Douglas fir; and, in the shadows, a shimmer of bright maple leaves.

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Suddenly, while we talked, the sound of a hammer drifted out of the forest. Each stroke made a resounding clang: steel rang on steel, echoing through the woods. Someone, it seemed, was spiking a tree right before our ears.

"Oh my goodness," Friedman said, grinning, "do you have a timber sale in there?"

"Why?" asked the Forest Service man. "Is that one of your friends?"

In spite of the joke, the sound was disturbing. It made some in the group pause as they looked over the splintered trees, as if to shake off a worry: that the fight over Earth has now come all the way to love and war.

The sound tolled across the mountainside. It had the relentless pace of alarm. It sounded as if someone in the forest were steadily and urgently ringing a bell.

A lumber company sued this group for illegally planting seedlings in a clear-cut area. "Feral Darryl" Cherney is at left in front.

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An Earth Day Reader

Let's say that you, the SMITHSONIAN reader, having digested (or at least sampled) the contents of this special issue on the environment, are seized by an urgent need to know more. But since you, like most of us, are not blessed with unlimited time and money, you must restrict your additional reading to a practical number of books. That number, of course, is ten.

It is a preposterous notion that anyone can pluck from the air the ten most important environmental books that have been published since Earth Day 1970. What I am going to do instead, therefore, is recommend a selection that I believe will provide the historical background, raw information and appreciation necessary to understand the character of our environmental dilemma and the clamoring need to address it. Naturally, this list is prey to the weaknesses of the breed—subjectivity, incompleteness and so on—but it is, as they say, a beginning.

Speaking of which, a number of good books have explored the roots of our relationship to the natural world, particularly the intellectual, spiritual and sociological baggage that Europeans brought to the American continents nearly five centuries ago and with which they managed to accomplish all manner of mischief. To my mind, however, no single book has so profoundly illuminated the spiritual character of that journey as *Beyond Geography: The Western Spirit Against the Wilderness* by Frederick Turner (Viking Press, 1980; now available in paperback from Rutgers University Press). Beautifully written and carefully argued, *Beyond Geography* traces the complex pairing

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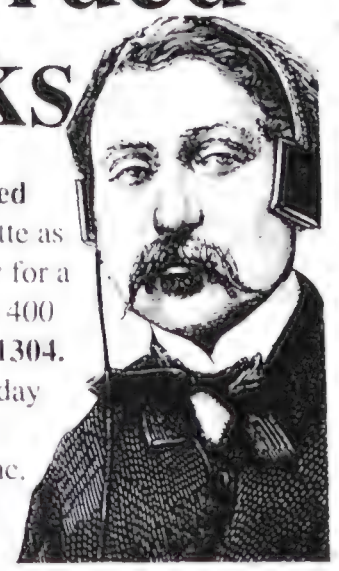

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of humankind and nature back to primitive times, then brings it forward through the various cultures that evolved among the peoples of the Near and Middle East, the Greeks and Romans, and the confused tribal ganglia of societies on the European continent and in ancient England. Along the way, Turner maps the tortured (and often torturing) progress of Christianity, and finally examines how this whole package of attitudes affected the exploitation of the New World. We know the outcome all too well. As early as 1825, Turner writes, "the wilderness of the East was a faded and vaguely disquieting memory, perhaps most evidenced by its negative reminders: vanished forests, erosion, opened, parched lands, and small pockets of aboriginal slums."

Yet, even as this dismal result was being played out—and the players preparing to turn their attention to the astonishing breadth of land and peoples that lay to the west—an antithetical quest was under way. The convoluted tracks of this second pilgrimage can best be followed in *John Muir and His Legacy: The American Conservation Movement* by Stephen Fox (Little Brown and Company, 1981). As the title suggests, the book is more than a fine biography of the hairy woodsprite who became the fountainhead of the wilderness preservation movement; it is a coherent narrative history up to modern times, as much a book of individual lives as it is of the ideas they embodied and promoted. And a colorful lot they were, too. In addition to Muir, whose whole long life is chronicled here, there are neatly drawn portraits of such giants as Concord's Henry David Thoreau and the Sierra Nevada's David Brower, diplomat-historian George Perkins

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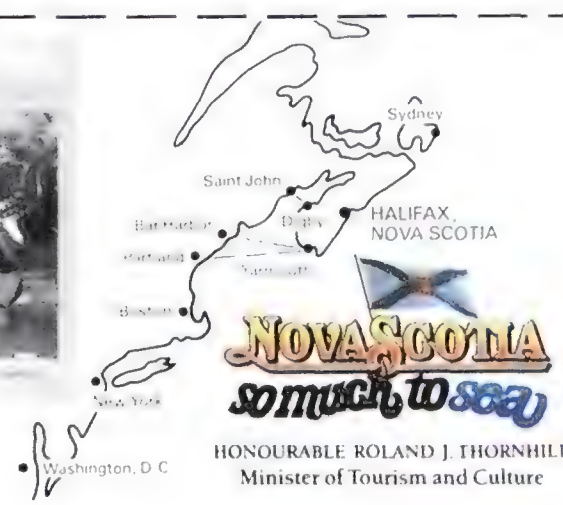

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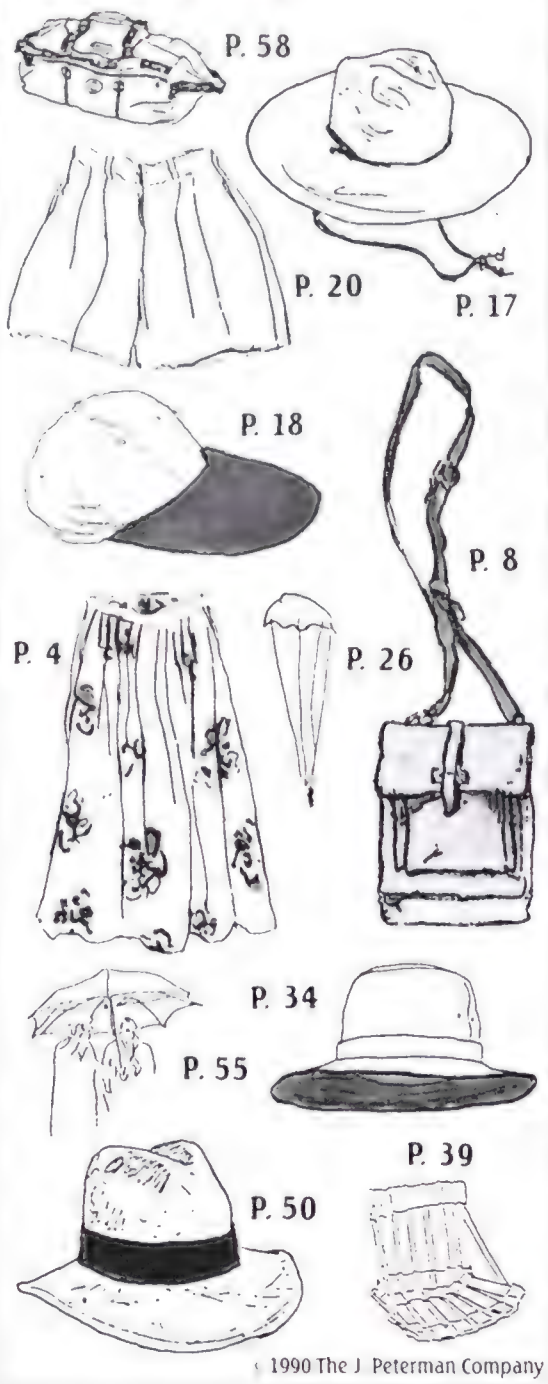

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S4

Woodsman John Muir once observed that "formality . . . frightens [me] dumb."

Marsh and feminist gadfly Rosalie Edge, journalist-historians Irving Brant and Bernard DeVoto, forester Gifford Pinchot and biologist Barry Commoner, editor Robert Underwood Johnson and cartoonist J. N. (Ding) Darling, Presidents Theodore and Franklin Roosevelt, and many, many more. Most important, all of these people are limned in a context that clarifies the great conservation battles and chronicles the growth of the organizations that head the movement today.

If you would know the story of American conservation, then you must read science as well as history. During the past 20 years, we have learned that when we damage the so-called web of life along any of its strands, we weaken the genetic "commons" that scientists refer to as biological diversity. It's hard to imagine a more compelling introduction to this subject than *Biophilia* by Edward O. Wilson (Harvard University Press, 1984). With this elegant little book, Wilson puts himself firmly in that pantheon of scientists—among them Loren Eiseley, Lewis Thomas and Stephen Jay Gould—who have raised their written work to the level of literature, much of it fueled equally by poetic instinct and scientific inquisitiveness. Nevertheless, the science is here in abundance, offered in support of an eloquent plea for a conservation ethic that is built upon the recognized interdependence of all species. "I suggest," Wilson concludes, "that as biological knowledge grows the ethic will shift fundamentally so that everywhere, for

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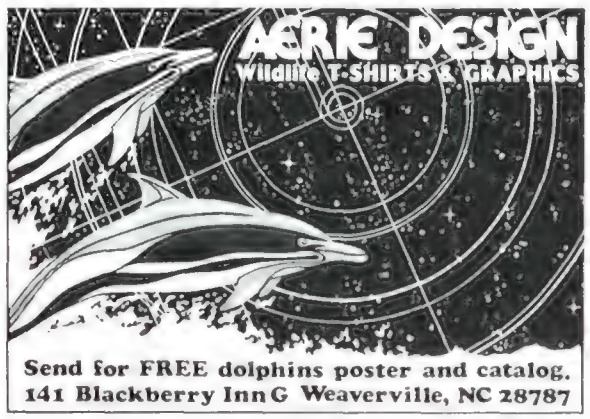

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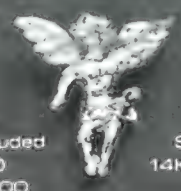

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reasons that have to do with the very fiber of the brain, the fauna and flora of a country will be thought part of the national heritage as important as its art, its language, and that astonishing blend of achievement and farce that has always defined our species."

There is no pretense to literature in *Extinction: The Causes and Consequences of the Disappearance of Species* by Paul R. and Anne H. Ehrlich (Random House, 1981). What *is* offered by this husband-and-wife team of Stanford University biologists serves as a kind of companion text to Wilson's graceful evocation, an excellent primer for the general reader in how the processes of extinction—both nature-driven and human-driven—have worked in the past (slowly), how they work today (swiftly), and what they hold for the future of the planet (biological ruin) if they are not held in check. In spite of its somewhat teachery prose, *Extinction* provides meaty discussions of everything from evolutionary theory to population biology and is replete with specific examples to illustrate its points.

No single volume could hope to outline Man's impact on the environment in exquisite detail. Still, two recent books manage to give it a try, and—unlike such gloom-ridden speculations as Bill McKibbin's provocative 1989 treatise, *The End of Nature* (Random House)—they provide the reader with a sliver or two of hope.

Edward Wilson's concept of biophilia was inspired by a forest in Suriname.

The Worldwatch Institute's seventh annual "Report on Progress Toward a Sustainable Society"—titled *State of the World 1990*, written by Lester Brown and others, published in Washington, D.C.—looks upon conditions through last year and finds them not good. Most of the elements of an ecology under siege are presented in some detail, as discussed in ten scholarly but readable essays by members of the Worldwatch Institute research staff. Here are the still half-understood phenomena of global warming and the greenhouse effect, as well as the better-known disasters of tropical deforestation, soil depletion, erosion, desertification, drought and the loss of agricultural productivity. Here, too, are the pressures of continuing population growth, starving human beings, the cycle of poverty, and the appalling drain on world economies and natural resources still being imposed by the protocols of war. As counterpoint to this dirge of damage, *State of*

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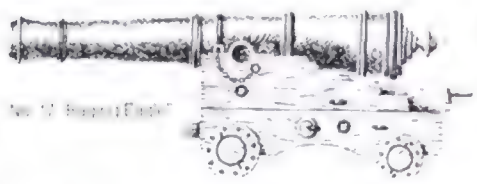

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the World also offers some specific solutions to some specific problems, puts forth some confidence in the rise of a worldwide environmental consciousness, and lays out the elements of what could become a sustainable society in the 1990s.

As we stagger with all deliberate caution into that new age, we could do worse than to carry with us *The Earth Report: The Essential Guide to Global Ecological Issues*, edited by Edward Goldsmith and Nicholas Hildyard (Price Stern Sloan Inc., 1988). Like *State of the World*, this collection features a series of knowledgeable essays on everything from pollution and acid rain to international food programs and the Gaia hypothesis, including an especially powerful examination of the world we have made by historian Donald Worster. What distinguishes this volume, however, is its wonderfully useful encyclopedia of items relating to the world's ecology and its problems. If you want to know how much americium-241, from the breakdown of plutonium-241 in nuclear reactors, was discharged into the Irish Sea between 1968 and 1978 (12,365.1 curies) or the number of food additives being used in the United Kingdom (3,850), this is the place to turn.

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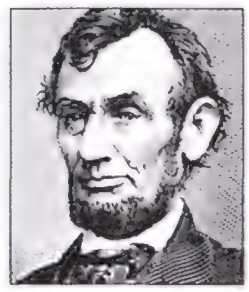

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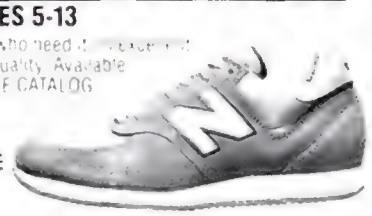

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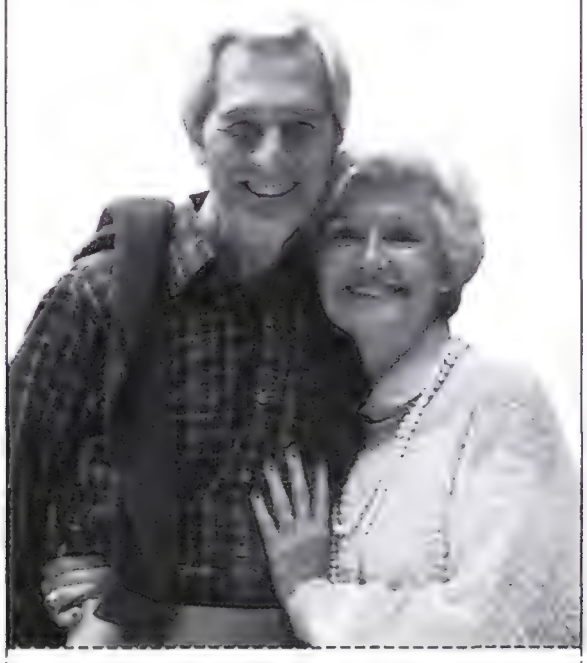

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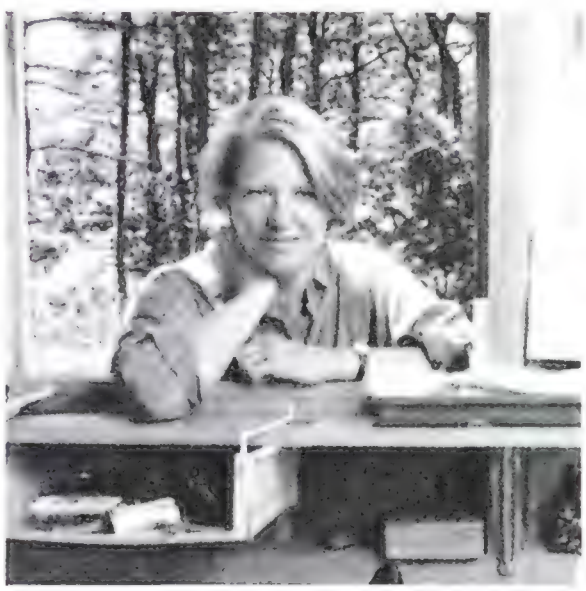
books in the long list of those attempting to explain the what and the why of the land west of the Mississippi and north of a given point: *The American West as Living Space* by Wallace Stegner (University of Michigan Press, 1987). A series of lectures put between covers, this slim volume draws upon the author's own beginnings and experiences in this largely arid region, enriches those memories with a profound knowledge of the land's history (which is infinitely more complex and troubling than that which has so often been told) and combines it all with a novelist's sensitivity. Stegner, whose essay on page 35 leads off this issue, has been doing this for a long time, of course, but rarely with better grace or more insight. If you want a brief and stylish introduction to the forces that continue to shape the West, you need look no further.

Finally, let me end this presumptuous bibliophile's excursion with the observation that among the land's greatest gifts to us have been the sparks of inspiration with which it has struck generation after generation of writers. From Ralph Waldo Emerson to E. B. White, Mary Austin to Sally Carrighar, the American land in particular has given birth to a body of literature that is the equal of any the world has ever enjoyed. In this case, to choose one writer's book over another's is a particularly odious task, so I will abdicate that responsibility by offering up two recent anthologies that strike me as among the best of *that* particular breed: *This Incomparable Lande: A Book of American Nature Writing*, edited by Thomas J. Lyon (Houghton Mifflin Company, 1989); and *Words from the Land: En-*



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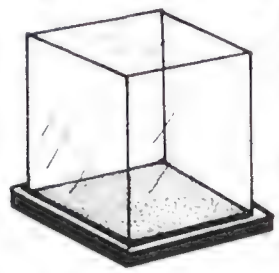

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counters with Natural History Writing, edited by Stephen Trimble (Gibbs Smith Publisher/Peregrine Smith Books, 1988). The Lyon anthology, which presents selections from 22 writers, beginning with William Wood of the 17th century and ending with John Hay of the 20th, is distinguished by an excellent introduction that traces the development of natural history writing in this country, as well as a long and extremely useful annotated bibliography. Trimble's book concentrates entirely on 20th-century writers and features brief, quote-studded essays about the authors themselves, explaining to varying degrees what it is about the land that appeals to them and how they shape that perception. Both books are rich with the language of informed observation and sometimes—as in the work of an Annie Dillard or a Barry Lopez—with an intensity of vision that can change our view of the natural world and our place in it forever.
T. H. Watkins

Mr. Watkins is editor of Wilderness *magazine and author of* Righteous Pilgrim, *a biography of FDR's Interior Secretary, Harold L. Ickes, that is scheduled for publication this fall.*

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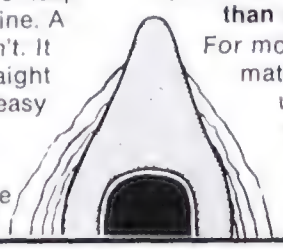

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Earth Day Forum

In observance of the Earth Day 20th anniversary, the National Museum of Natural History presents a daylong public forum, "Earth Day 1990: Shaping a New Environmental Agenda," on April 21. Speakers include Paul Ehrlich, professor of biological sciences, Stanford; John Holdren, professor of energy and resources, Berkeley; Thomas Lovejoy, Assistant Secretary for External Affairs, Smithsonian Institution. Forum hours are 8:30 A.M. to 3 P.M. in Baird Auditorium, NMNH; admission $6. Call (202) 357-2700.

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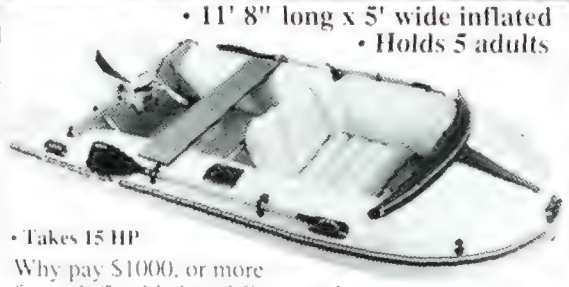

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National Museum of Natural History
Dinamation's Dinosaurs, Alive and in Color (April 12-September 3) A menagerie of 18 animated robotic dinos.
Twentieth Century Dinosaurs (April 12-August 10) Life-size models by sculptor Jim Gary.
Portraits of the Great Saturniid Moths (through June 1) A series of illustrations by John Cody.

National Museum of American History
Shawls in America (through October) Wraps and coverlets from the museum's Division of Textiles.
Men and Women: A History of Costume, Gender and Power (through December) An examination of culturally determined appearance and behavior.

Anacostia Museum
The Real McCoy: African-American Invention and Innovation, 1619-1930 (through May) An overview of outstanding black inventors and anonymous innovators.

National Museum of African Art
Icons: Ideals and Power in the Art of Africa (through September 3) A survey of African art, focusing on recurrent themes.

National Museum of American Art
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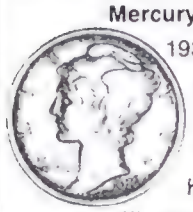
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National Portrait Gallery
Oliphant's Presidents: Twenty-five Years of Caricature (April 6-March 1991) The political cartoonist's satiric sketches.
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Hirshhorn Museum & Sculpture Garden
Culture and Commentary: An Eighties Perspective (through May 6) Works reflecting the changing society of the past decade.
DIRECTIONS: Ilya Kabakov (through June 3) A mixed-media representation of Soviet life.

National Air and Space Museum
Drawings and Things by Rowland Emett (through December) A lighthearted look at airplanes and spacecraft.
Commuting in the Modern Manner: The Grumman Goose Amphibian (indefinite) A look back at the 1930s "limousine of the air."
Beyond the Limits: Flight Enters the Computer Age A major new gallery explores the computer revolution in aerospace.

Cooper-Hewitt Museum (New York)
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Exhibition catalogs

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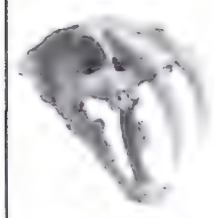
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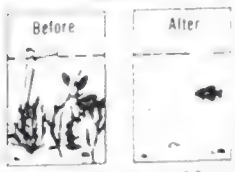

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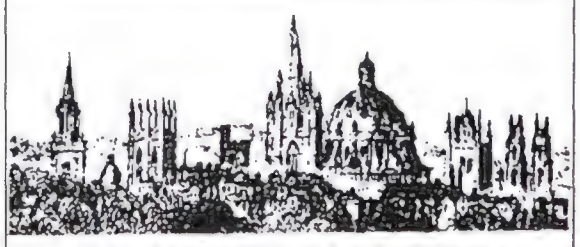

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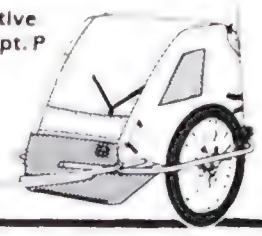

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Smithsonian World: The season's fourth program, "Nigerian Art: Kindred Spirits," will air May 2. Check local PBS listings for exact time.

Lecture and Seminar Program

The Program hosts events in Salina, Kansas, April 5-8, and Topeka, Kansas, April 6-8. During May, the Program travels to Toledo, Ohio, May 4-6; Concord and Manchester, New Hampshire, May 4-6; and Phoenix, Arizona, May 3-6.

For information on these and additional offerings, write to Lecture and Seminar Program, U.S. and International Events Program, 490 L'Enfant Plaza S.W., Suite 4210, Washington, D.C. 20560, or call (202) 287-3210.

Resident Associate Program

To become a Resident Associate, or for fee and ticket information, call 357-3030. Here are some April events:

Denmark in Perspective: Great Danes and their Friends (Tuesdays at 8 P.M.; April 17-June 12) A nine-week series of performers from Garrison Keillor to Victor Borge.

In the Orchestra with the NSO (May 6; 4-5:30 P.M.) A performance for families, featuring the National Symphony Orchestra accompanying a puppet show.

Smithsonian Institution Traveling Exhibition Service

SITES organizes and circulates exhibitions to cities throughout the United States and abroad. To sponsor a show in your community, write SITES, Smithsonian, Washington, D.C. 20560. Here are some April exhibits:

Concord, New Hampshire (April 7-May 6) *Vietnam Veterans Memorial: A National Experience*, St. Paul's School.

Los Angeles, California (through May 27) *Tropical Rainforests: A Disappearing Treasure*, Natural History Museum of Los Angeles County. See *Highlights continued*, page 218.

Wheeling, West Virginia (April 7-May 20) *Ceramics of the Weimar Republic*, Oglebay Institute Mansion Museum.

Wisconsin Rapids, Wisconsin (through April 22) *Daughters of the Desert: Women Anthropologists and the Native American Southwest, 1880-1980*, McMillan Memorial Library.

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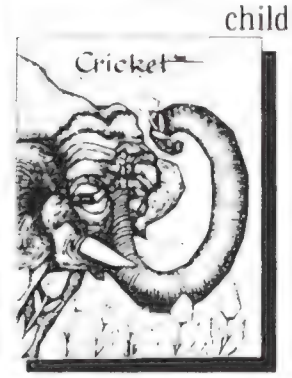

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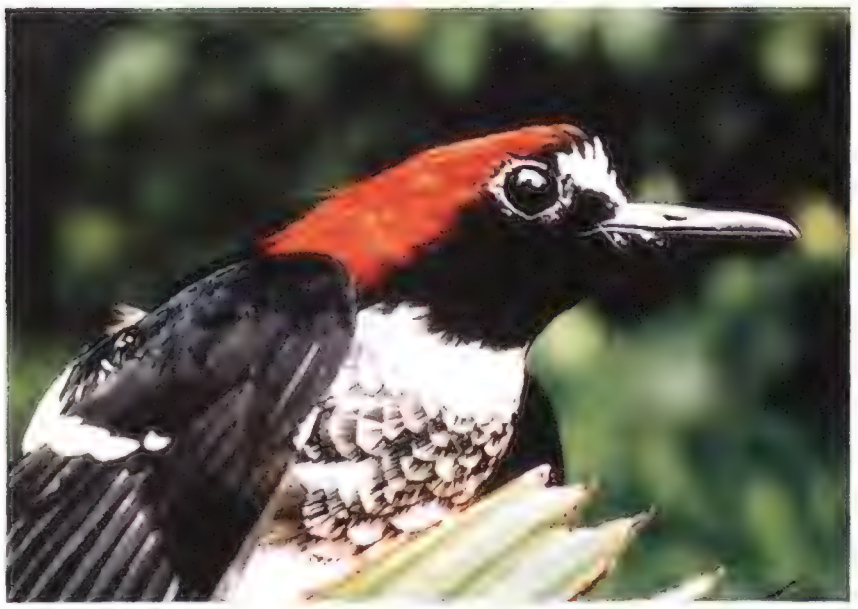
5SMN6

The forest's fragile fabric



The white-crowned forktail is found along stream banks throughout Borneo.

"Tropical forests," observes Smithsonian exhibit curator Judith Gradwohl, "once grew on an area twice the size of the United States. Today less than half of that forested land remains, yet most of the destruction occurred within the past 30 years."

The headlong ravaging of that lush, mysterious terrain, home to more than half the world's plant and animal species, is the subject of "Tropical Rainforests: A Disappearing Treasure." Organized and circulated by the Smithsonian Institution Traveling Exhibition Service in cooperation with the World Wildlife Fund, the exhibit is now traveling nationally through January 1994.

In tropical Asia, the Singapore rhododendron is a common sight.

Originally conceived by project director Martha Cappelletti, "Rainforests" took shape in the hands of specialists —among them, ecologists and zoologists, anthropologists and botanists— from throughout the National Museum of Natural History, the National Zoo and the Smithsonian Tropical Research Institute in Panama.

The result of their efforts is an excursion into the heart of the vanishing forests—the preserve of panther and toucan, orangutan and orchid. The exhibition opens with a five-screen slide-and-sound show, filmed for SITES in Mulu National Forest, Borneo. (Photographs taken during the expedition are at right.)

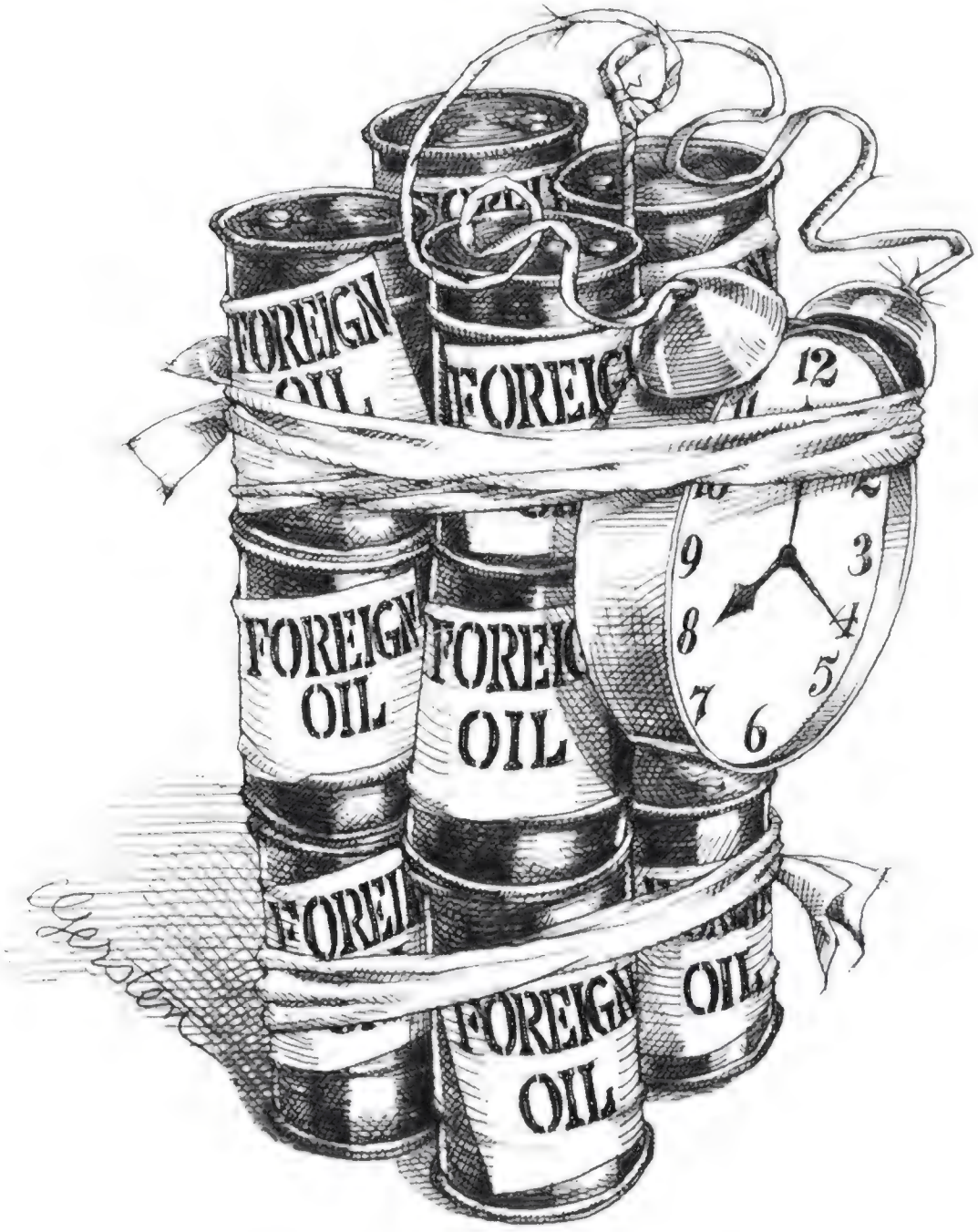
Visitors will explore forest ecology, indigenous cultures, consequences of the destruction, and steps toward solutions, through dioramas, photomurals, models, a videodisk computer game, scientific specimens, ethnographic objects and interactive installations.

The show remains at the Natural History Museum of Los Angeles County through May 27, and continues on to San Diego; Boston; New York; Denver; St. Louis; Houston; Atlanta; Glencoe, Illinois; St. Paul; Cleveland.

Kathleen M. Burke

Longhorn beetle's dappled patterning camouflages insect on rain forest floor.

Translucent-winged swallowtail favors forest riverbeds and mud-puddle pools.



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Special Weekend Programs
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Southwest Indians *May 24-June 3 or August 23-September 2*

✸ **Alaskan Landscapes** *June 21-July 3*

✸ **Colorado for Families** *June 24-30*

✸ **Grand Canyon Rafting** *June 29-July 8 or July 27-August 5*

Pueblo Indians *July 14-22* Based in Santa Fe; concludes with a crafts fair.

✸ **Salmon River Rafting** *July 18-26*

Aspen, Colorado *July 28-August 2* Enjoy private art collections, music festival.

✸ **Alaska Cruise** *July 30-August 10*

✸ **Lewis and Clark** *August 5-12* Horseback camping on the 1805 trail in Idaho.

Railroading the Rockies *August 10-18*

Baseball Nostalgia *August 13-19* Chicago, Detroit and Cleveland; *September 5-11* Boston, New York and Baltimore.

✸ **Black Hills and Tetons** *August 15-25*

✸ **Waterton-Glacier** *August 22-September 1* Hike in Montana and Canada.

Delta Queen *September 4-12* Cincinnati to Chattanooga.

Boston-to-Washington, D.C. Cruise *September 11-22*

✸ **Wild California** *September 16-25* Hike in Yosemite.

Columbia River Cruise *September 20-30*

✸ **California's Channel Islands Cruise** *October 8-13 or October 15-20*

Foreign Study Tours

European Countryside Programs *May-October* Relax in Austria, Denmark, England, France, Hungary, Italy or Wales.

Southern Italy and Sicily *April 28-May 12*

Morocco Treasures *April 28-May 12*

✸ **Zimbabwe-Botswana** *May 8-25*

Istanbul and Beyond *May 9-24*

Gardens of Yorkshire *May 12-25* Includes London's Chelsea Flower Show.

Two Chinas *May 20-June 2* Explore Hong Kong and Taiwan.

✸ **Brazil Parks** *May 23-June 7*

Waterways of France and Spain *May 24-June 7* Cruise from Seville to Southampton.

✸ **Cotswold Walks** *May 24-June 5 or October 4-16* Leisurely walks northwest of London.

Golden Ring (USSR) *May 26-June 9 or September 1-15* Old Russian towns.

Danube Voyage *May 27-June 12* Art and history from Romania to West Germany.

Poland *June 8-24*

Russia by Train *June 13-July 1 or June 23-July 11* Includes Riga and Murmansk.

Amsterdam-Dutch Countryside *June 14-27* See Van Gogh centenary exhibitions.

Shadows of the Past (France) *June 16-29* Chateaus, caves and villages of Dordogne.

✸ **Swiss Walks** *June 20-July 5*

✸ **Lake District Walks** *June 28-July 9* Walks and hikes through northwest England.

✸ **Galápagos Islands and Quito** *July 1-12* Aboard the new *Isabela II.*

Scotland by Train *July 5-18*

✸ **Walks in Austria and Italy** *July 11-25*

Mediterranean Cruise *July 12-23*

England for Families *July 16-26*

✸ **Kenya** *August 6-22* Tent safari.

Edinburgh Music Festival *August 12-22*

Canada *August 16-27* Visit major cities; cruise the St. Lawrence.

Volga Cruise *August 18-September 6*

Byzantium Voyage *August 20-September 4* Venice to Istanbul on the *Argonaut.*

Eastern Turkey *August 29-September 15*

Battle of Britain *September 4-17* 50th-anniversary commemorative tour.

Rhineland *September 6-18* Major cities; four-night cruise.

✸ **Indonesia** *September 6-27*

Central Asia (USSR) *September 7-19*

Three Republics (USSR) *September 8-23* Russia, Georgia, Estonia.

English Canals *September 11-23*

Yugoslavia *September 11-23*

The Golden Age of Spain *September 11-23*

Glasnost and Perestroika (USSR) *September 12-22* Study current affairs with Soviet scholars in Moscow and Tallinn.

Switzerland by Train *September 12-24*

✸ **Ireland Walk** *September 13-24*

Rhône Cruise *September 18-October 2* Provence, Burgundy, Paris.

Brazil *October 2-19*

Nepal and Thailand *October 6-26*

Turkey and Greece *October 11-24* Cruise aboard the tall ship *Sea Cloud.*

Splendors of South China Seas *October 11-31* Hong Kong, Thailand, Java, Bali.

Impressionists (France) *October 14-28* Nice, Aix-en-Provence and environs.

Japan *October 15-27*

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SMITHSONIAN-STYLE

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Trinity College (Ireland) *August 11-25*

Rome *September 13-25*

Oxford *September 15-29*

Aircraft Restoration *September 24-27* Study with craftsmen at the Paul E. Garber Facility near Washington, D.C.

Salzburg *October 6-17* Live in a restored castle; visit Vienna.

American Folk Art *October 9-12* Washington, D.C.

Santa Fe Art-Archaeology *October 21-27*

Research Expeditions

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Washington, D.C. *May 23-June 6* Photo-document Memorial Day activities.

Washington, D.C. *June 6-16* Prepare anthropology collections of animal bones.

Washington, D.C. *June 25-July 8* Photograph the Festival of American Folklife.

Montserrat *July 1-14, 15-28 or July 29-August 11* Excavate a sugar plantation.

• **Cody, Wyoming** *July 15-28* Collect plant fossils near Yellowstone.

Cheyenne, Wyoming *July 18-30* Document the annual Frontier Days rodeo.

Washington, D.C. *July 22-August 4* Archive historic aviation documents.

New York City *August 1-11* Reconstruct Caribbean pottery.

Orofino, Idaho *September 12-20* Record Lumberjack Days festivities.

• **Costa Rica** *October* Study volcanic eruptions and local vegetation.

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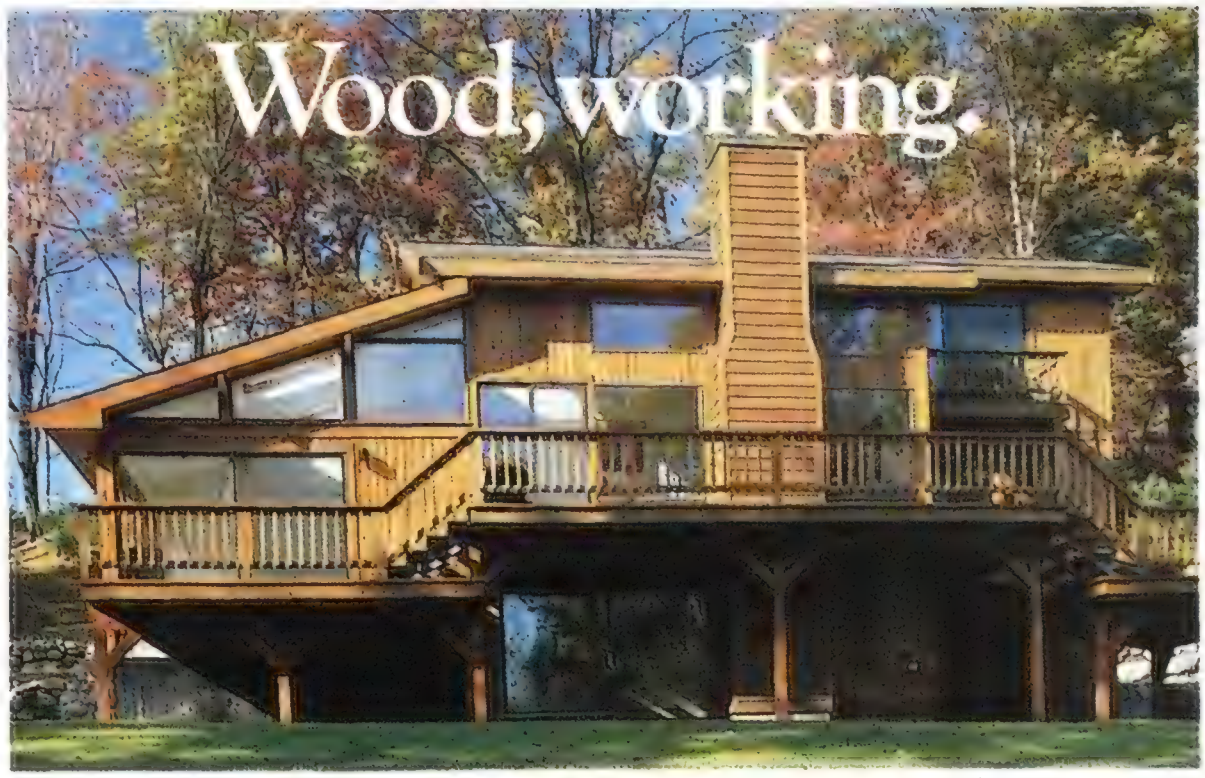

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By Donald Dale Jackson

For a do-badder, it's extra hard to do good

Like most good ideas at our house, this one came from my wife, Darlene. From now on, she announced not long ago, we are going to live environmentally responsible lives. First we would bone up on the literature; then we'd start doing our part. I went along wholeheartedly. It so happened that I had been planning to become a better person for some time.

We weren't bad, as consumers go—we'd been recycling newspapers, bottles and cans for years—but once we started reading, we could see the full extent of our shortfall, lifestyle-wise. We studied Diane MacEachern's *Save Our Planet: 750 Everyday Ways You Can Help Clean Up the Earth* and *The Green Consumer*. We read a lot of magazine articles, too. I could have done without the righteous philosophizing in some of them—"Pursue depth and richness of experience rather than intensity"—but many of the ideas were sensible.

We began by shopping more responsibly. We passed up the transparent bags in the produce section and dropped our vegetables into the cart naked. We opted for paper bags at the checkout counter or brought our own cloth sack. The bag boys stared at us, and people in line grumbled whenever our sack fell off the rack, but look—you have to rise above that sort of thing.

Our first setback came when we tried to apply what we'd learned about responsible pet care. One book said that the flea collars our dog, Dulcie, had been wearing for years were full of potentially dangerous chemicals. It suggested that as an alternative we make a pulp from orange and grapefruit peels to rub into her fur. We tried it. Dulcie started leaping and squirming, and finally got away. She returned three days later wearing an expression indicating that we were on probation.

Living ecologically provoked some low-beam marital spats, but Darlene and I didn't start bickering in earnest until Christmas approached. She'd consulted the "Save Our Planet Holiday List" and had found some novel gifts. "What would you think about a set of biodegradable, no-phosphate cleansers for Dale and Kathi?" she asked, referring to our son and daughter-in-law. I said that cleanser struck me as a pretty goofy present.

"There are lots of other ideas here," she went on, listing some of them: compact fluorescent light bulbs (they last longer and use less power) for daughter Amy; a toilet dam (saves water) for my brother. "Your parents might like toilet tissue made from recycled paper, or some unbleached coffee filters."

Somehow, I said when she had finished, those things didn't seem very festive. That did it. "You never had any intention of going along with this," she sputtered. I acknowledged that, yes, I *was* daunted by the idea that every single act has a moral consequence in ecological terms. "I can't handle the pressure!" I protested.

"Grow up," she demanded.

I agreed to take another stab at it. It was soon afterward that my subconscious got involved. I dreamed that I was at this place that looked like an environmental workout center. It was filled with people I knew, doing strange and uplifting things. My friend Julie was unknitting old sweaters so she could reuse the yarn. Leon had his exercise bike hooked up to a gristmill so he could grind his own flour. Mrs. Hodgson was feeding leftovers to the worms in her kitchen composter. Meanwhile, I pushed my old lawn mower around and briskly composted the clippings. I awoke a recommitted citizen.

Then Darlene's mother came to live with us. The Original Recycler, if you know what I mean. This woman was saving string and Christmas wrapping paper long before people were writing books about it. Challenged by her sudden proximity, I shifted into high gear. I turned off the faucet while brushing my teeth and started writing on both sides of a piece of paper. But Grandma was as hard to emulate as ever. She saved plastic pots to return to the plant store. She darned socks until they looked cable-stitched. I couldn't keep up with her.

Eventually, I fell off the uplift wagon altogether. It happened after I started supplementing the experts' ideas with some of my own. My initial proposals were serious. I suggested abandoning Kleenex in favor of handkerchiefs, for example. Then I began to get giddy. Darlene laughed it off when I said we'd save water if I showered with the divorcée down the street, but when I proposed commuting to work by balloon, she realized that I had veered off into mockery again. "It's the ecologically responsible way to travel," I explained.

When she glared at me with cold contempt, I decided to confess. "I'll be honest with you," I said. "I can't pull it off. Do-goodism makes me squirm. Sometimes I have this irresistible urge to run out for a Super Burger and then throw all the packaging out the window."

"It's one thing to scoff at do-gooders," she snapped. "It's something else to be a do-badder."

I think she gave up on me after that. I do worry about my inability to sustain virtuous behavior, so it comforts me to remember that there were sinners on the Crusades, too. I'll try to do better, but meanwhile I'm working on a book of my own. I call it *116 Fun Little Ways to Help Mother Nature If You're Not Up to Making Big Sacrifices Right Now*. It will be printed on recycled paper.

Nigerian batik by Oyenike

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